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SELECTIVITY IN CHEMICAL REACTIONS *

By H. I. WATERMAN † (Hon. Fellow) and A. B. R. WEBER †

SUMMARY

The practical importance of functions predicting reaction courses for simultaneous reactions is pointed out. Simultaneous reactions are then distinguished into consecutive, side, and parallel reactions, and reaction courses are calculated for each of these selectivity types, assuming first-order kinetics. The results are plotted in triangular diagrams.

It is then shown that at high temperatures the course of the catalytic hydrogenation of linoleic esters is in accordance with the assumption of a consecutive first-order reaction, while unexpected deviations are obtained at lower temperatures. Further it is mentioned that the derivation of sound theoretical functions is practically impossible for many complex simultaneous reactions. For these reasons a practical method for characterizing catalysts for such processes and for the investigation of the effect of the reaction variables do not exist yet.

It has been found for many simultaneous reactions that the concentration changes in the reaction products, as a result of the variation of a reaction variable, can be approximated by functions, containing two constants. The reaction products are herewith considered as *pseudo* three-component systems. It is proposed to apply the functions for choosing catalysts for such processes and for an economic investigation of the influence of the reaction variables on the reaction course.

INTRODUCTION

IN many chemical processes two or more reactions occur simultaneously, while often only one of the reactions is desired. Research is then carried out to find catalysts or process conditions which will direct the total reaction in the desired course. In the following it will be shown that the study of such reactions can be facilitated by a graphic method, including:

(1) the considering of complex reaction products as *pseudo* three-component systems;

(2) the plotting of reaction courses in triangular diagrams;

(3) the application of functions which predict the mutual concentration change of the components.

It is clear that the knowledge of functions, which predict the concentrations of the three mentioned components, is of practical importance. If such a function contains n constants, at least n experiments should be carried out to determine the function and to learn therefrom the obtainable concentrations of the three components. For some simple processes it is possible to derive such functions and to plot theoretical reaction courses in triangular diagrams. This will be carried out for three different types of selectivity which are usually distinguished in chemical reactions.[1]

REACTION COURSES FOR SIMULTANEOUS FIRST-ORDER REACTIONS IN BATCH PROCEDURE

Consecutive Reactions

The desired product is an intermediate which can react further to give undesired by-products. The reaction scheme for this type of selectivity can be represented by

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

in which k_1 and k_2 are velocity constants. It can be deduced that

$$\alpha_B = \frac{S}{S-1}(1-\alpha_A)\left[(1-\alpha_A)^{\frac{1-S}{S}} - 1\right]$$

where α_B = the fraction of initial A converted to B;
α_A = the fraction of A reacted;
$S = k_1/k_2$ = the selectivity factor.

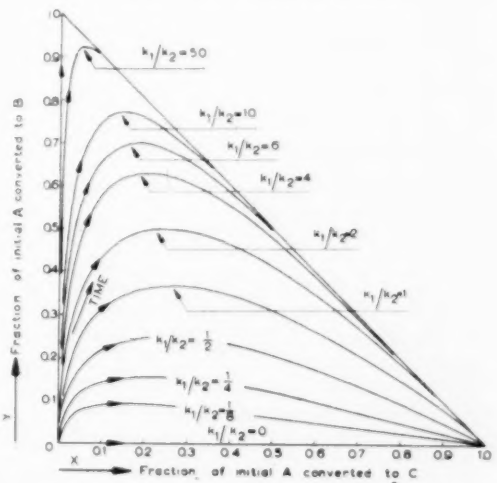

FIG 1

REACTION COURSES FOR CONSECUTIVE FIRST-ORDER REACTIONS IN BATCH PROCEDURE

Reaction scheme: $A \xrightarrow{k_1} B \xrightarrow{k_2} C$

The function contains one constant S, one experiment being sufficient in this case to determine the function. Fig 1 shows some calculated reaction courses for different values of the ratio k_1/k_2.

* MS received 2 September 1957.

† University of Chemical Engineering, Delft, Holland.

Side Reactions

In some processes the reacting substance is removed by two or more reactions, one of them being undesired.

The reaction scheme can be symbolized by

$$A \xrightarrow{k_1} B$$
$$\downarrow k_2$$
$$C$$

and it can be derived that

$$\alpha_B = S\alpha_C$$

in which

α_B = the fraction of initial A converted to B;
α_C = the fraction of initial A converted to C;
$S = k_1/k_2$.

The function contains one constant, one experiment being sufficient to determine the reaction course at specific conditions. In Fig 2 some reaction courses are shown for different values of the ratio k_1/k_2.

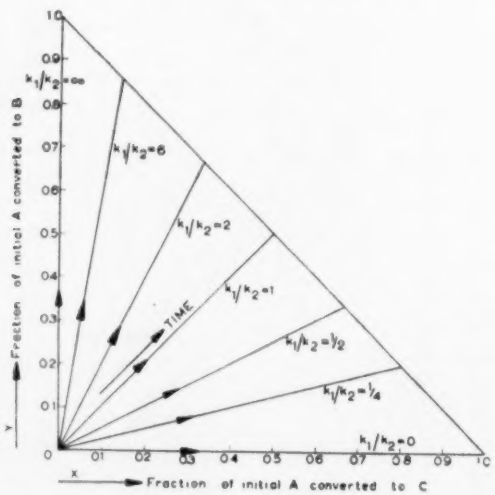

FIG 2

REACTION COURSES FOR FIRST-ORDER SIDE REACTIONS

Reaction scheme: $A \xrightarrow{k_1} B$, $A \xrightarrow{k_2} C$

Parallel Reactions

The starting material consists of two or more components, which react with different velocity. The reaction scheme for a two-component mixture can be represented by

$$A \xrightarrow{k_1} B$$
$$C \xrightarrow{k_2} D$$

It can be deduced that

$$\alpha_A = 1 - (1 - \alpha_C)^S$$

in which α_A and α_C represent the fractions of A and C reacted and S the ratio k_1/k_2. The function contains one constant, so also in this case one experiment is needed to determine the reaction course. Fig 3

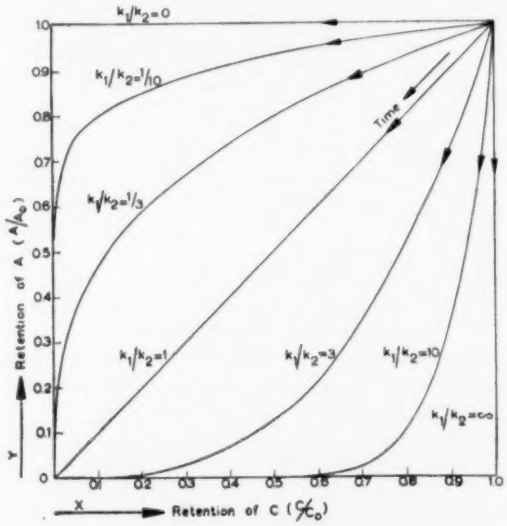

FIG 3

REACTION COURSES FOR FIRST-ORDER PARALLEL REACTIONS

Reaction scheme: $A \xrightarrow{k_1} B$, $C \xrightarrow{k_2} D$

shows some calculated reaction courses for a mixture of A and C.

Recently, the catalytic hydrogenation of linoleic esters has been discussed by Boelhouwer [2] as a simple example of a consecutive first-order reaction, the reaction scheme being represented by

$$\text{Linoleic ester} \xrightarrow{k_1} \text{Oleic ester} \xrightarrow{k_2} \text{Stearic ester}$$

In Figs 4 and 5 the results of a series of experiments are given, which were carried out at high temperatures (Fig 4) and at low temperatures (Fig 5).

It can be seen from Fig 4 that the hydrogenation at high temperature proceeds according to the assumption of a consecutive first-order reaction and that high ratios of k_1/k_2 can be obtained. It is then possible to transform the linoleic esters chiefly into oleic esters, while the formation of stearic esters is restricted. In contrast with these experiments, the hydrogenations at lower temperatures (Fig 5) gave considerable deviations from the theoretical curves, which were attributed to transport phenomena of the reactants at the catalyst surface.[2] It appears from this investi-

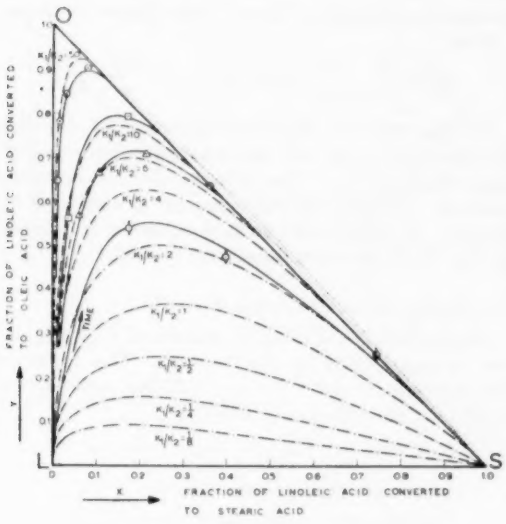

FIG 4

HYDROGENATION OF LINOLEIC ESTERS AT A HIGH TEMPERATURE

- ○ 2% Ni–kieselguhr, 180° C, 1 atm
- ⊡ 30% Ni–kieselguhr, 180° C, 1 atm
- △ 10% Pt–carbon, 180° C, 1 atm
- ⬡ 2% Ni–kieselguhr, 180° C, 100 atm

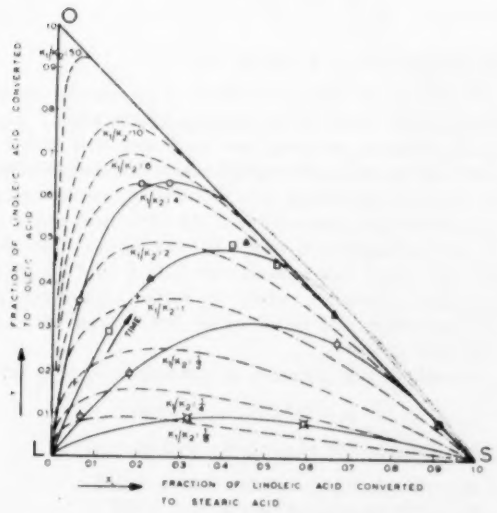

FIG 5

HYDROGENATION OF LINOLEIC ESTERS AT LOWER TEMPERATURES

- ○ 2½% Ni–kieselguhr, 90° C, 1 atm
- ⊡ 10% Pt–carbon, 30° C, 1 atm
- △ 3% Ni–kieselguhr, 50° C, 100 atm
- \+ 10% Pt–carbon, 30° C, 0·1 atm
- ⬡ 10% Pt–carbon, 20° C, 100 atm
- ⬡ 10% Pt–carbon, 50° C, 100 atm

gation that, even in a relatively simple case, kinetic functions can be insufficient to predict reaction courses. Besides, many processes are more complicated than the above-discussed process, *e.g.* the reaction may be a combination of the three selectivity types, the order of the reaction may deviate from one, the procedure (batch, continuous) may be complicated, and the starting material and the reaction products may be complex mixtures. It is obvious that such complicated reactions are not always suitable for kinetic studies, and in many cases

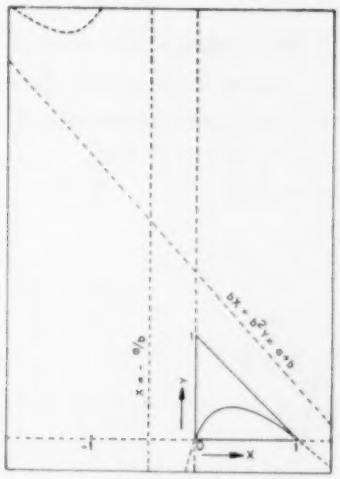

FIG 6

GRAPHIC REPRESENTATION OF THE EQUATION

$$ij = \frac{x(1-x)}{a+bx} \quad (a = 0{\cdot}4;\ b = 0{\cdot}9)$$

it is practically impossible to derive sound theoretical functions.[11]

In the following it will be shown that a systematic study of complex, simultaneous reactions is still possible when use is made of an empirical relationship, describing the important concentration changes in the reaction product, namely, the conversion of the starting material, the formation of desired products, and the formation of by-products. Along these lines every reaction product obtained from a single reactant may be regarded as a *pseudo* three-component system. Representing the fraction of desired products by ij and the fraction of by-products by x, the relationship between ij and x, as a result of the variation of a reaction variable, appeared to be

$$ij = \frac{x(1-x)}{a+bx} \quad . \quad . \quad . \quad . \quad (1)$$

in which ij and x are the two co-ordinate lines of the diagram, while a and b are constants. Equation (1) represents a hyperbola, the equations of the asymptotes being $x = -a/b$ and $bx + b^2ij = a + b$. It

must be emphasized that only the part of the hyperbola within the triangle has practical significance (Fig 6). If the starting material consists of two or more reactants, for example A and B, the reaction products can still be regarded as three-component systems. The three components are, in this case, unconverted A, unconverted B, and the formed products together. An analogous hyperbolic function, describing reaction courses, is proposed for these cases:

$$ij = x + \frac{x(1 - x)}{a + bx}$$

in which ij and x represent the retention of A, indicated by $\frac{A}{A_o}$, and of B, indicated by $\frac{B}{B_o}$, respectively (Fig 7). A_o is the initial concentration of A and B_o

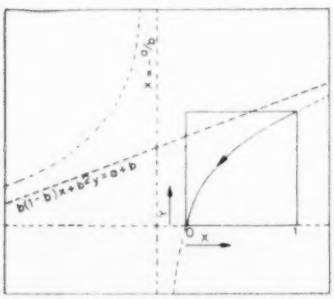

FIG 7

GRAPHIC REPRESENTATION OF THE EQUATION

$$ij = x + \frac{x(1 - x)}{a + bx} \quad (a = 0{\cdot}4;\ b = 1{\cdot}6)$$

the initial concentration of B. The equations of the asymptotes are in this case $x = -\frac{a}{b}$ and $bx(1 - b) + b^2y = a + b$.

The applicability of the functions will now be demonstrated for some processes, which are described in the literature. In most of these processes only the influence of one reaction variable was reported.

First, experimental data were plotted in triangular diagrams. Next, the numerical values of a and b were solved by combining data of points lying right and left from the top of the curve. With the obtained values of a and b the hyperbolas were constructed and compared to the experimental data. When there was a considerable deviation between the calculated curves and the data, other combinations of data were tried for the evaluation of a and b, till finally values were obtained which gave a reasonable agreement between the calculated curves and the experimental data.

Examples of Reaction Courses According to the Equations

$$ij = \frac{x(1 - x)}{a + bx} \quad \text{and} \quad ij = x + \frac{x(1 - x)}{a + bx}$$

In Figs 8–22 the experimental results of different processes are given and also reaction courses according to the functions. The influence of the investigated reaction variables (on enlargement) is indicated by arrows. In Figs 8–19 the first equation is applied; in Figs 20–22 the second equation is used.

(1) *Hydrogenation of Linoleic Esters* [2, 3]

The experimental reaction courses in Figs 4 and 5 can be represented by the function. The values of the constants a and b for the different series of experiments are collected in Table I.

TABLE I

Catalytic Hydrogenation of Linoleic Esters

Reaction courses according to the function $ij = \frac{x(1 - x)}{a + bx}$

	Conditions	a	b
High-temperature hydrogenations	2% Ni–kieselguhr, 180° C, 1 atm	0·0065	0·947
	30% Ni–kieselguhr, 180° C, 1 atm	0·0272	0·886
	10% Pt–carbon, 180° C, 1 atm	0·0481	0·880
	2% Ni–kieselguhr, 180° C, 100 atm	0·0950	0·978
Low-temperature hydrogenations	2½% Ni–kieselguhr, 90° C, 1 atm	0·117	0·712
	10% Pt–carbon, 30° C, 1 atm	0·340	0·398
	3% Ni–kieselguhr, 50° C, 100 atm	0·340	0·398
	10% Pt–carbon, 30° C, 0·1 atm	0·340	0·398
	10% Pt–carbon, 20° C, 100 atm	0·747	0·128
	10% Pt–carbon, 50° C, 100 atm	1·66	2·21

(2) *Modification of Vegetable Oils*

Vegetable oils can be modified by saturating one or more double bonds of the combined fatty acids. The hydrogenations, as described by Bailey and Fisher,[4] were carried out with a nickel catalyst and the course of the hydrogenations was followed by determining the percentage composition of the fatty acid portions in the hydrogenated oils. It was found that the hydrogenation was selective at 375° F and 15 p.s.i. hydrogen pressure, while a rather non-selective hydrogenation was obtained at 250° F and 60 p.s.i. hydrogen pressure.

Selective hydrogenation of cottonseed oil (Fig 8):

$$a = 0{\cdot}0108;\ b = 0{\cdot}980$$

initial composition of the fatty acid portion:

S_o = Wt fraction of stearic acid = 0·266
O_o = Wt fraction of oleic acid = 0·291
L_o = Wt fraction of linoleic acid = 0·443
Li_o = Wt fraction of linolenic acid = 0

Selective hydrogenation of soybean oil (Fig 9):

$$a = 0{\cdot}0050;\ b = 1{\cdot}01$$

initial composition of the fatty acid portion:

$S_o = 0{\cdot}143$ $\quad$ $L_o = 0{\cdot}510$
$O_o = 0{\cdot}282$ $\quad$ $L_o = 0{\cdot}065$

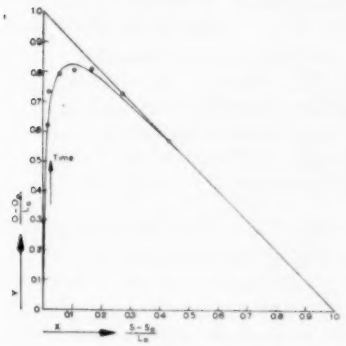

FIG 8

SELECTIVE HYDROGENATION OF COTTONSEED OIL

(375° F; 15 p.s.i. hydrogen pressure)

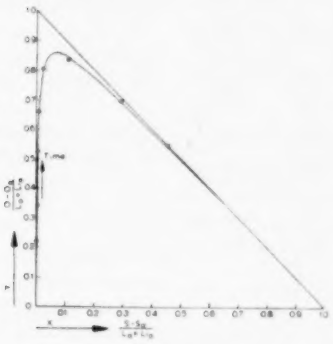

FIG 9

SELECTIVE HYDROGENATION OF SOYBEAN OIL

(375° F; 15 p.s.i. hydrogen pressure)

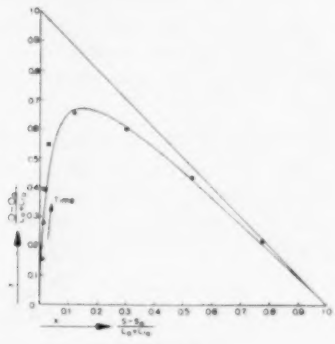

FIG 10

SELECTIVE HYDROGENATION OF LINSEED OIL

(375° F; 15 p.s.i. hydrogen pressure)

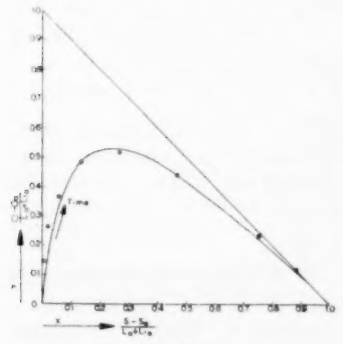

FIG 11

NON-SELECTIVE HYDROGENATION OF LINSEED OIL

(250° F; 60 p.s.i. hydrogen pressure)

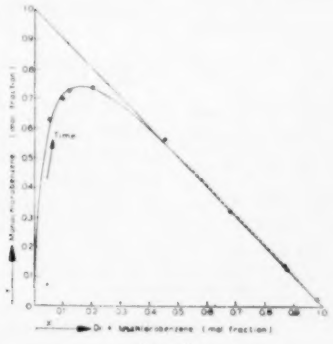

FIG 12

CHLORINATION OF BENZENE

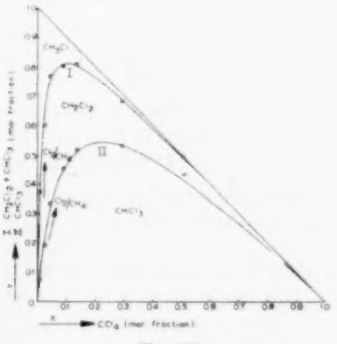

FIG 13

CHLORINATION OF METHANE

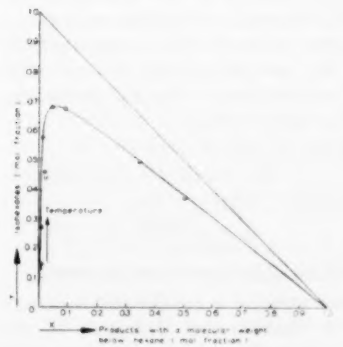

FIG 14

HYDRO-ISOMERIZATION OF *n*-HEXANE

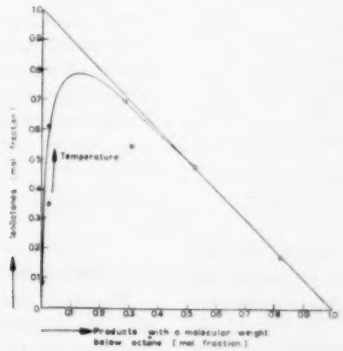

FIG 15

HYDRO-ISOMERIZATION OF *n*-OCTANE

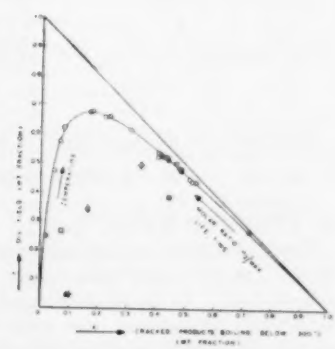

FIG 16

HYDRO-ISOMERIZATION OF PARAFFIN WAX

○ Experiments with platinum-containing catalysts

△+□◇▷◁ Experiments with other catalysts

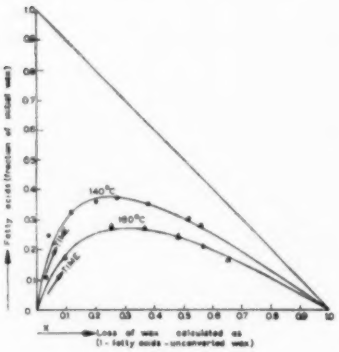

FIG 17

OXIDATION OF PARAFFIN WAX

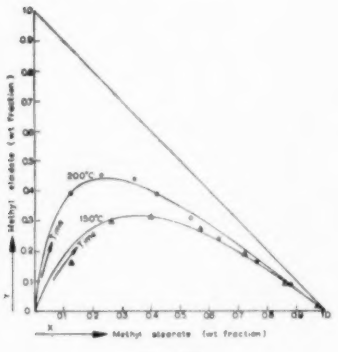

FIG 18

ISOMERIZATION OF METHYL OLEATE

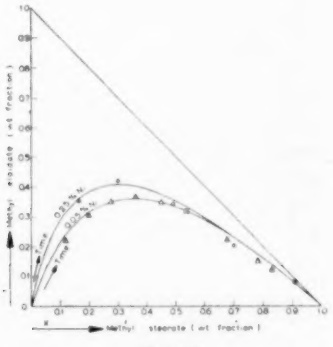

FIG 19

ISOMERIZATION OF METHYL OLEATE

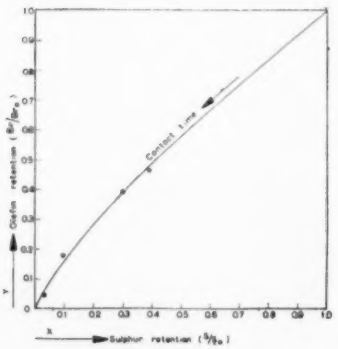

FIG 20

HYDROTREATING OF SHALE GASOLINE (300° C)

S_o = initial sulphur content = 0·340
Br_o = initial bromine number = 41·4

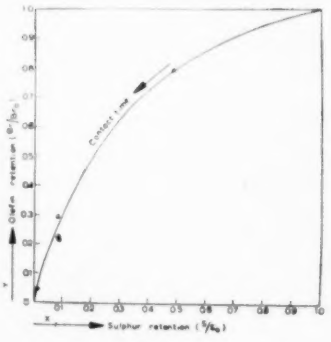

FIG 21

HYDROTREATING OF SHALE GASOLINE (325° C)

S_o = 0·190; Br_o = 32·0

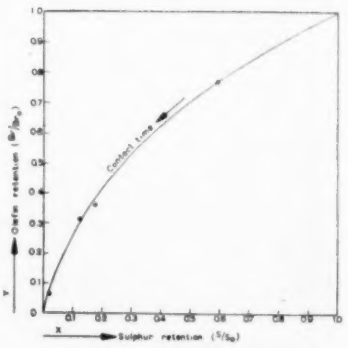

FIG 22

HYDROTREATING OF SHALE GASOLINE (375° C)

S_o = 0·0678; Br_o = 17·7

Selective hydrogenation of linseed oil (Fig 10):

$$a = 0{\cdot}0320;\ b = 1{\cdot}05$$

initial composition of the fatty acid portion:

$S_o = 0{\cdot}089$ $\quad L_o = 0{\cdot}221$
$O_o = 0{\cdot}170$ $\quad L_o = 0{\cdot}520$

Non-selective hydrogenation of linseed oil (Fig 11):

$$a = 0{\cdot}108;\ b = 0{\cdot}985$$

(3) *Chlorination of Benzene*

The chlorination of benzene was studied by MacMullin [5] at 55° C and with anhydrous ferric chloride as a catalyst. In the series of experiments the amount of chlorine introduced was varied. In Fig 12 the concentration change of the components unconverted, benzene–monochlorobenzene–(di + trichlorobenzene), can be seen ($a = 0{\cdot}0340$; $b = 0{\cdot}922$).

(4) *Chlorination of Methane*

The thermal chlorination of methane was studied by Hass, McBee *et al.*[6] In the experiments methane was passed through a reactor at 440° C and atmospheric pressure, while chlorine was introduced through jets spaced along the reactor. The molar ratio of chlorine/methane was varied between 0·5 and 3·30 in the series of experiments. Fig 13 shows the concentration changes of the groups:

I. $CH_3Cl - (CH_2Cl_2 + CHCl_3) - CCl_4$
($a = 0{\cdot}0124$; $b = 0{\cdot}987$);

II. $(CH_3Cl + CH_2Cl_2) - CHCl_3 - CCl_4$
($a = 0{\cdot}0922$; $b = 1{\cdot}01$).

(5) *Hydro-isomerization of* n-*Hexane and* n-*Octane*

The hydro-isomerization of *n*-hexane and *n*-octane was investigated by Ciapetta and Hunter.[7] In the experiments the hydrocarbons were vaporized and contacted with a platinum catalyst on a support of silica–alumina (total pressure 24·8 atm, liquid hourly space velocity = 1·0 l/l/hr, and molar ratio hydrogen/*n*-hexane = 4). In the series of experiments the temperature was varied in the range 330°–420° C for *n*-hexane and from 260° to 380° C for *n*-octane.

The concentration changes are given in Figs 14 and 15 for the groups:

n-hexane–*iso*hexanes–lower molecular weight products ($a = 0.0045$; $b = 1.30$). (Table III of the paper of Ciapetta and Hunter.)

n-octane–*iso*-octanes–lower molecular weight products ($a = 0.0175$; $b = 0.970$). (Table IV of the paper of Ciapetta and Hunter.)

(6) *Hydro-isomerization of Paraffin Wax*

The hydro-isomerization of paraffin wax was studied by the present authors.[8] In the experiments paraffin wax was vaporized and contacted with a platinum catalyst on an acid-promoted support of alumina at 32–102 atm hydrogen pressure, 410°–450° C, weight hourly space velocity = 1, and molar ratio hydrogen/wax = 61–183. In the experiments the reaction temperature, molar ratio hydrogen/wax, and lifetime of the catalyst were varied.

The concentration change in the reaction product is given in Fig 16 for the group:

Unconverted wax–oil–cracked products ($a = 0.040$; $b = 0.995$).

The cracked products were obtained after atmospheric distillation of the reaction products to 300° C, and the unconverted wax and oil were obtained after a dewaxing treatment of the distillation residue at −20° C.

(7) *Oxidation of Paraffin Wax*

The oxidation of a Fischer–Tropsch wax was studied by Pardun [9] at different temperatures with manganese stearate as a catalyst. Pardun also proposed some practical functions describing the relationship between the wax conversion and the formation of fatty acids, oxy acids, and water-soluble acids.

In the experiments the oxidation time was varied. In Fig 17 the initial amount of wax is taken as unity. The yield of fatty acids and the amount of unconverted wax are expressed as fractions of this unity. The difference 1 − (fatty acids + unconverted wax) is taken as a loss of wax owing to the formation of by-products, which include oxy acids, water-soluble acids, and gaseous reaction products. This method is rather arbitrary.

In Fig 17 the relation is given for the group:

Unconverted wax–fatty acids–loss of wax
at 160° C: $a = 0.344$; $b = 1.43$
at 140° C: $a = 0.164$; $b = 1.33$

(8) *Isomerization of Methyl Oleate*

The hydrogenation of methyl oleate at atmospheric pressure with nickel as a catalyst was studied by Feuge.[10] During the hydrogenation the saturation of the double bond and the formation of trans-isomers go side by side. In the experiments the reaction time was varied at different temperatures and at different catalyst concentrations (*cf.* Figs 4 and 6 of the paper by Feuge). The concentration changes in the reaction products are given in Figs 18 and 19 for the group:

Methyl oleate–methyl elaidate–methyl stearate
at 200° (0.25% Ni catalyst) $a = 0.129$; $b = 1.18$
at 150° (0.25% Ni catalyst) $a = 0.389$; $b = 0.943$
at 175° (0.25% Ni catalyst) $a = 0.210$; $b = 1.01$
at 175° (0.05% Ni catalyst) $a = 0.350$; $b = 0.804$

(9) *Selective Hydrotreating of Shale Gasoline*

The simultaneous hydrogenation of olefins and thiophenes in shale gasoline was studied by Bertil Hammar.[11]

The selectivity of the process at different conditions was judged by determining bromine numbers (Br) and sulphur contents (S) of the reaction products. In Figs 20–22, reaction courses, according to the equation

$$ij = x + \frac{x(1-x)}{a+bx}$$

are given for different temperatures. The contact time was varied in the series of experiments (*cf.* Table VI of the paper of Bertil Hammar).

Fig 20 (300° C, S_o = initial sulphur content = 0.340; Br_o = initial bromine number = 41.4. $a = 1.06$; $b = 4.10$).
Fig 21 (325° C, $S_o = 0.190$; $Br_o = 32.0$. $a = 0.418$; $b = 1.64$).
Fig 22 (375° C, $S_o = 0.0678$; $Br_o = 17.7$. $a = 0.364$; $b = 0.943$).

DISCUSSION

In the given examples the concentrations in the reaction products change according to an equation containing two constants. The reaction products were taken as three-component systems.

Two cases have been considered:

(*a*) The starting material is one of the components. The primary reaction product, being mostly an intermediate, is taken as the second, while the end-product is the third component.

(*b*) If the starting material consists of two reactants, both are considered as components. The formed products are taken together as the third component.

The validity of the functions should be checked when a new process is investigated. The functions can then be applied, especially in those cases where no sound theoretical functions can be derived.

The principles discussed above have been applied in an earlier paper, dealing with the hydro-isomerization of paraffin wax,[8] in which a method for catalyst

selection was proposed. Several catalysts were then tested at an identical condition, the isomerization reaction being accompanied by a cracking reaction for all catalysts. The results obtained were plotted in triangular diagrams (Fig 23), after which two lines were drawn through the experimental point and two angular points representing the starting material and the completely cracked product. The two lines enclose an area which includes all hyperbolas of the equation

$$ij = \frac{x(1-x)}{a+bx}$$

which go through the angular points and the experimental point.

The area represents all products which can be obtained when one reaction variable is changed with respect to the conditions of the experimental point, the area thus being a rather broad base of comparison for the catalysts tested. After comparing the various areas a certain number of catalysts can be selected for further investigation, which includes a second experiment with the selected catalysts, *e.g.* at a temperature differing from the first experiment. The values of a and b can then be evaluated for these catalysts and the various curves constructed. After comparing the curves, a certain number of catalysts can be selected again.

Another example, concerning the selective hydrotreating of shale gasoline [11] will be given. In Figs 24 and 25 the results of two experiments with different catalysts tested at identical conditions are given. From the constructed areas it can be seen that Co–Mo–SiO_2–Al_2O_3 is a better catalyst than Fe–Al_2O_3, as it shows a better olefin retention.

When catalysts have been selected, the influence of reaction variables on the product distribution can be investigated. By applying the functions a considerable saving of the number of experiments can be achieved.

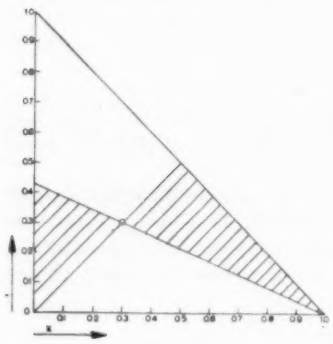

FIG 23

CONSTRUCTION OF THE AREA WHICH INCLUDES ALL HYPERBOLAS OF THE EQUATION $ij = \frac{x(1-x)}{a+bx}$, GOING THROUGH THE EXPERIMENTAL POINT AND THE ANGULAR POINTS ($x = 0$; $ij = 0$) AND ($x = 1$; $ij = 0$)

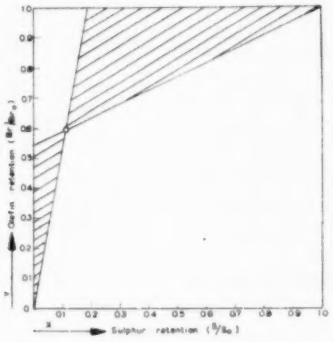

FIG 24

HYDROTREATING OF SHALE GASOLINE WITH A Co–Mo–SiO_2–Al_2O_3 CATALYST

(425° C, contact time 13·8 sec, total pressure = 15 atm, molar ratio H_2/gasoline = 1·75)

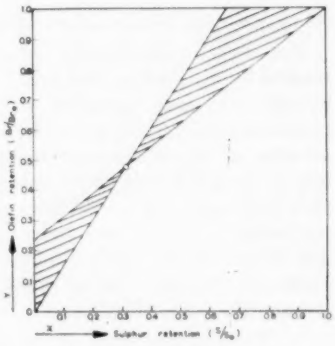

FIG 25

HYDROTREATING OF SHALE GASOLINE WITH A Fe–Al_2O_3 CATALYST

(425° C, contact time 13·3 sec, total pressure = 15 atm, molar ratio H_2/gasoline = 1·75)

ACKNOWLEDGMENT

The authors appreciate the contribution of F. Th. G. J. van der Leeuw and W. J. van der Weerdt in the present work.

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HYDROCARBON RESEARCH GROUP REPORT—1954–56

In 1954 a summary report of the Group's activities after its first ten years was published. During the three subsequent academic years beginning October 1953 the support of university research work has continued with the help of the subscriptions from the members who remained, *i.e.* British Petroleum Co. Ltd, Esso Development Co. Ltd (now Esso Research Ltd), Imperial Chemical Industries Ltd, the Ministry of Supply, Monsanto Chemicals Ltd, National Coal Board, "Shell" Research Ltd, and Trinidad Oil Company Ltd.

Trinidad Oil Company resigned from the Group at the end of 1956, but Burmah Oil Company, Distillers Company Ltd, and Mobil Oil Company Ltd have accepted membership for 1957–58 which will allow continuity in the research programmes.

The Group's activities have been sustained most vigorously by three Panels made up of representatives from the member bodies and co-opted university workers.

The *Hydrocarbon Chemistry Panel* has continued to sponsor research in the organic chemistry of hydrocarbons, the general emphasis being towards the elucidation of mechanisms of reactions rather than actual synthesis of pure specimens of particular compounds. Sponsorship of certain centres ceased, and opportunity was taken to include new recipients. Reactions involving alkylation, isomerization, halogenation, and oxidation formed the major part of the investigations. Research into the fundamentals of gas chromatography commenced, the main objectives being the studies of static adsorption properties of materials and the adsorption of vapours by thin liquid films. Over this period more than £11,000 has assisted this work at Birmingham, Bristol, Oxford, Bedford College, London, and Queen Mary College.

In May/June 1956 the panel organized a successful symposium on gas chromatography which attracted nearly 400 members. (A second symposium is planned in Amsterdam for Spring 1958 in conjunction with the Royal Dutch Chemical Society.) Arising from the great interest shown in this technique, a decision was taken to form a Discussion Group, which would be responsible for holding further meetings and for the collection, assessment, and distribution of data on the subject.

The *Spectroscopic Panel* has continued its considerable activities in aiding and promoting research work in infra-red and ultra-violet spectrometry and also extended its support to include the more recent technique of nuclear magnetic resonance. Over £6400 has assisted this work at Cambridge, Oxford, and King's College, London, during this period.

Much of the effort has been devoted to the development of new or improved equipment, including high resolution grating infra-red spectrometers, a reflecting microscope unit (the first of its kind to give double beam operation) for use in the infra-red region, two instruments (a fluorite prism spectrometer and a grating monochromator) for work in the vacuum ultra-violet region, a double beam attachment which can be used in both the ultra-violet and vacuum ultra-violet regions, a wide frequency range nuclear magnetic resonance spectrometer and a permanent magnet type high resolution nuclear magnetic resonance instrument, all of which are now in operation.

High resolution investigations in the infra-red region have been directed to obtaining molecular vibration and rotational constants and molecular dimensions, while work has continued on effects of various factors on the position and intensity of key infra-red absorption bands with the object of improving procedures for structural diagnosis and also of investigating the possible relationship between band intensity and chemical activity. Other work in the infra-red region has included studies of molecules adsorbed on surfaces, rotational isomerism studies, the use of deuterated materials for structural analysis, investigations on oriented fibres and polymers using a double beam microscope technique with polarized radiation, measurements in the 1–5-μ region, the study of the spectra of n-paraffins in the crystalline solid state, and investigations on the emission spectra of small molecules.

In the vacuum ultra-violet region absorption spectra of a large number of molecules, including polynuclear aromatics, have been obtained, while the grating monochromator is now being used for direct photo-ionization studies.

Nuclear magnetic resonance has been applied to the determination of structure of various materials and to the study of molecular packing and motion in various aromatic compounds, while resonance spectra of certain fluorine compounds have also been examined.

A large number of publications have resulted from this work, and many papers are awaiting publication. An international conference on molecular spectroscopy was held by the Panel in London in October 1954, and arrangements are now being made for a similar conference in London on 27 and 28 February 1958.

During the same period the *Mass Spectrometry Panel* continued to support research work in the universities of Birmingham, Liverpool, and London (King's College) on a number of topics concerned with the development of the mass spectrometer and with its application to a wide variety of physical chemical studies. Over £4400 has been allocated to this research.

Work at Birmingham has included the study of some effects occurring in the ion source of a mass spectrometer, and the study of oxidation of hydrocarbons initiated by atomic oxygen using a mass spectrometer coupled to a molecular beam generator.

The mass spectrometer has been used at Liverpool to measure ionization potentials by a pulsed-electron technique. Substances investigated included methyl halides, water, and ammonia, and the results obtained confirm the energy levels predicted by molecular orbital theory. The appearance potentials of the methyl, methylene, methine, and carbon ions have also been determined by the pyrolysis of suitable substances within the mass spectrometer.

At King's College, London, the study of surface reactions on filaments has yielded results of considerable interest, which may help in the elucidation of catalysis. Systems studied include the dehydrogenation of ethane at low pressure on platinum and tungsten filaments, with the effect of water vapour. An ingenious technique has been devised to permit the study of the rate of evaporation of molecules from a metal surface, and by this means data can be obtained which will be of fundamental importance in adsorption theory.

The panel organized a highly successful conference on applied mass spectrometry in 1953, and will be holding another in London in conjunction with the American Society for Testing Materials in September 1958.

J. W. Barrett,
Chairman

October 1957

OBITUARY

R. T. MANNING
B. HAYWARD

It is with deep regret that we record the deaths of two Associate Fellows of the Institute, R. T. Manning and B. Hayward who, with Mrs Manning and Mrs Hayward, were killed when the aircraft in which they were returning to Bahrain after being on leave in Turkey crashed. The crash occurred shortly after take-off from Beirut.

Both Bob Manning and Bernard Hayward had been firm friends since attending Manchester University and, on graduation in 1952, both joined the Bahrain Petroleum Company Ltd.

Bob Manning was employed as a process engineer in the Technical Services Division of the Research and Development Department and was chiefly concerned with water treating problems, especially in the ionic process for demineralizing drinking water.

Although it was not until 1956 that he joined the Institute, his enthusiasm made him the obvious choice as secretary of the Bahrain Branch, and he fulfilled his duties with great efficiency and personal charm. Both Bob and his wife were keen supporters of all spheres of the Branch activities.

In May 1957 he presented to the Branch a paper on "Demineralization of Saline Waters by Electrodialysis." This was a great success, and was acclaimed by a large and interested audience.

Bernard Hayward was employed as senior designs engineer of the Engineering Department of the Bahrain Petroleum Company Ltd, and was chiefly connected with refinery process design problems.

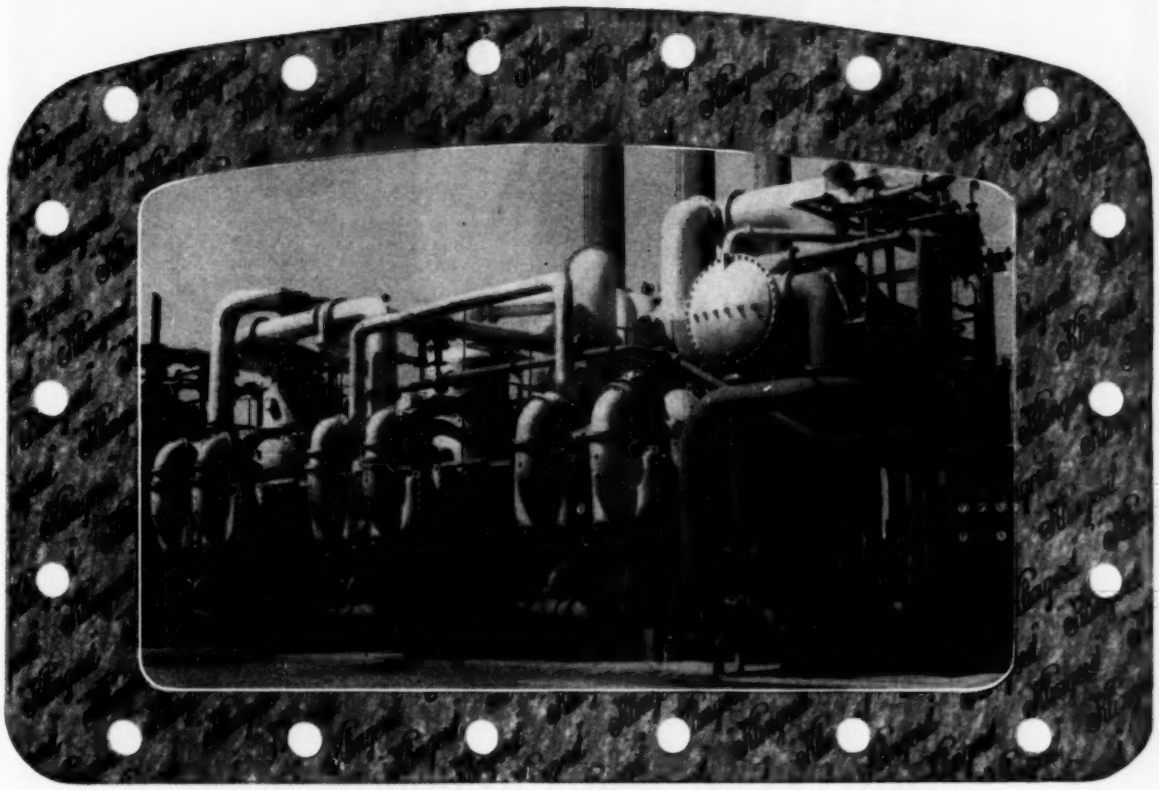
His considerable professional ability combined with uncommon strength of character brought him rapid promotion, and there is no doubt that a highly successful career lay before him.

Bernard joined the Institute in 1956 and was an active member of the Bahrain Branch activities.

The loss of Mr and Mrs Manning and Mr and Mrs Hayward was deeply felt not only by the Branch but also by their many friends in Bahrain.

D. G. J.

Cut out for the job!



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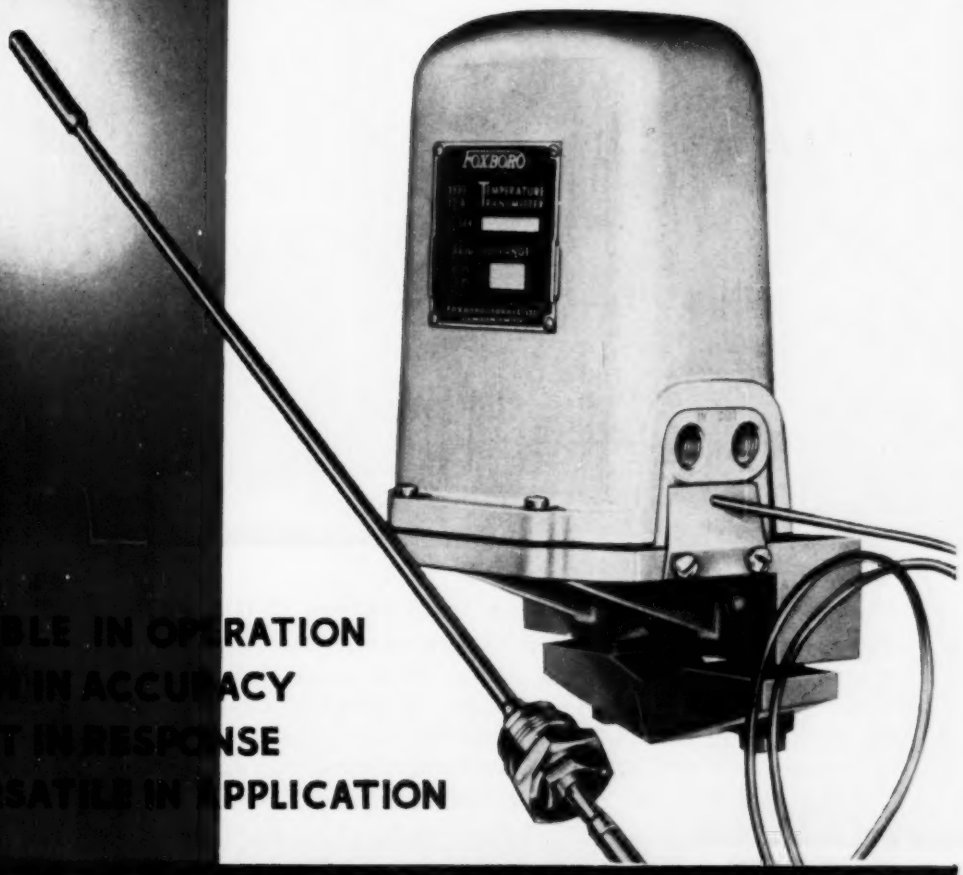

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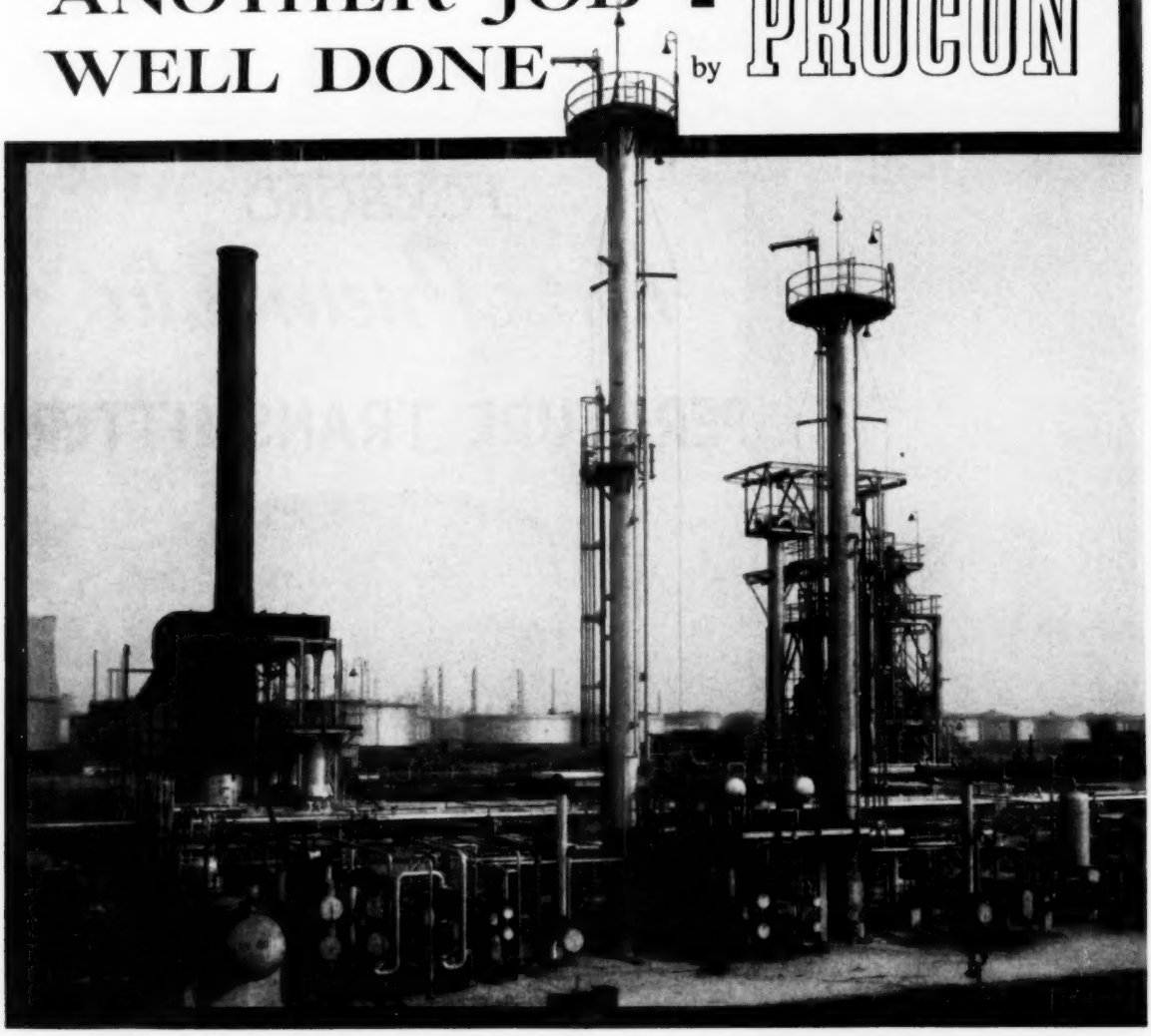

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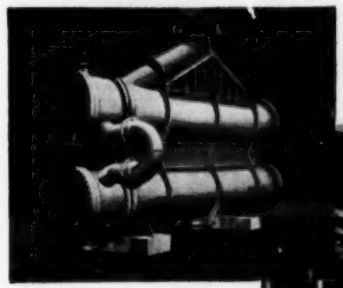
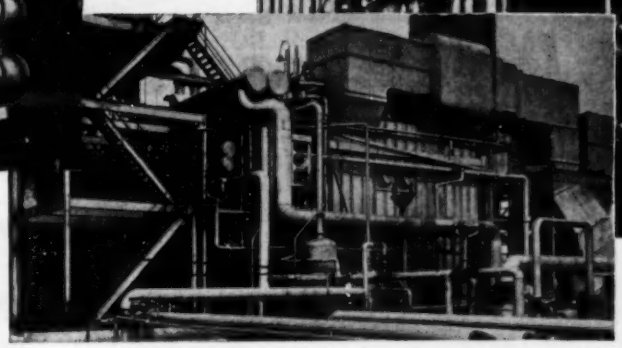
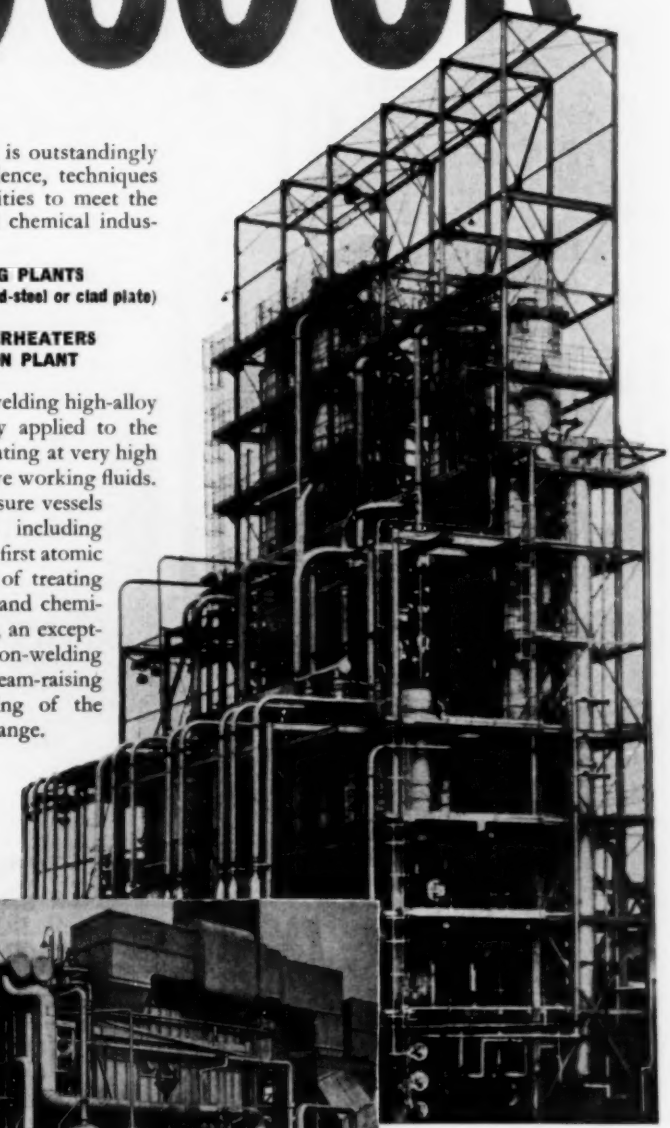


Heat-exchanger built by Babcock for service in an oil refinery.



One of a number of Babcock Integral-Furnace boilers, fired by refinery-gas and- or oil; in an "outdoor" type installation, at a large oil refinery.



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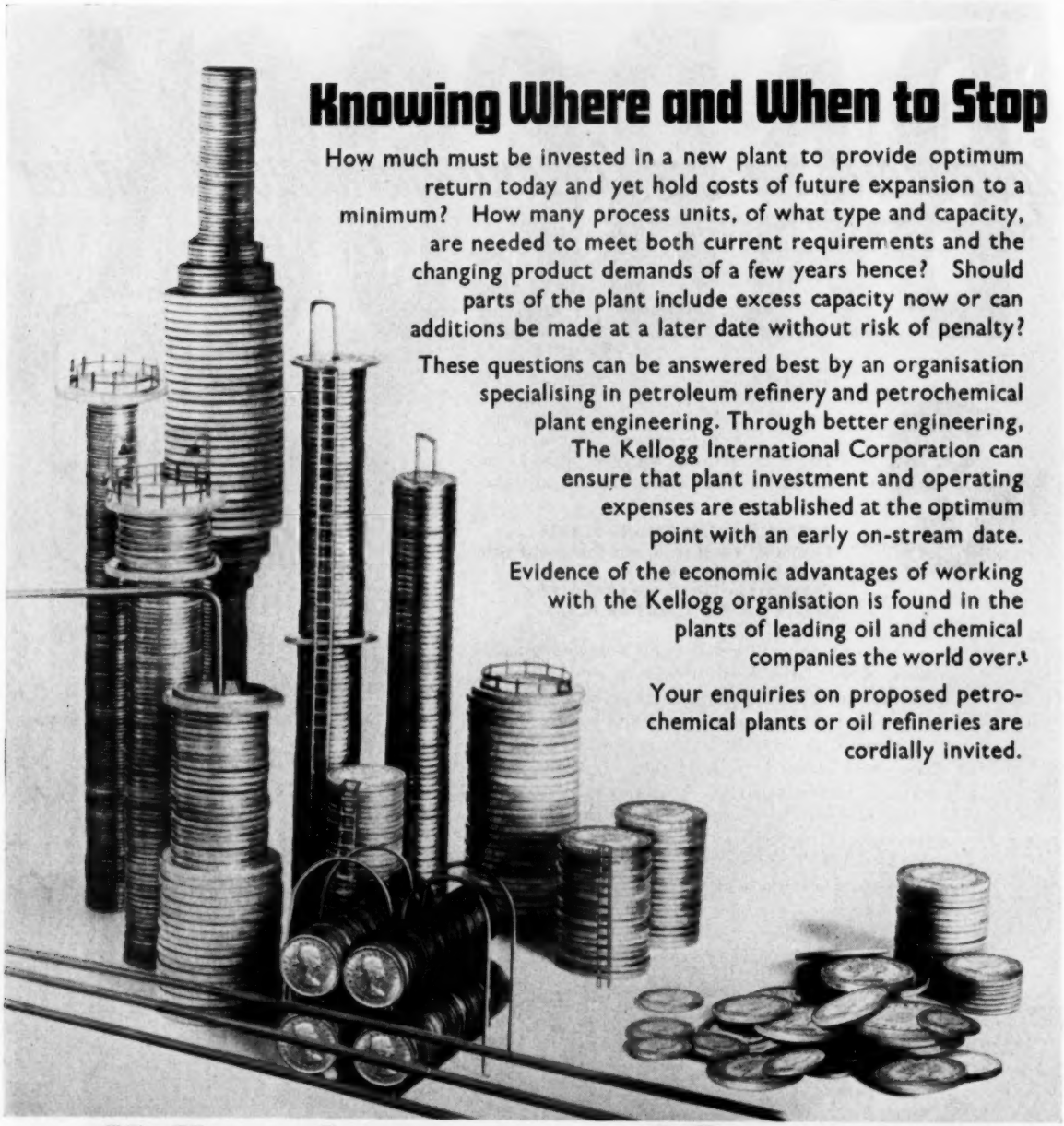

Knowing Where and When to Stop

How much must be invested in a new plant to provide optimum return today and yet hold costs of future expansion to a minimum? How many process units, of what type and capacity, are needed to meet both current requirements and the changing product demands of a few years hence? Should parts of the plant include excess capacity now or can additions be made at a later date without risk of penalty?

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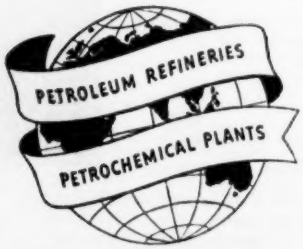

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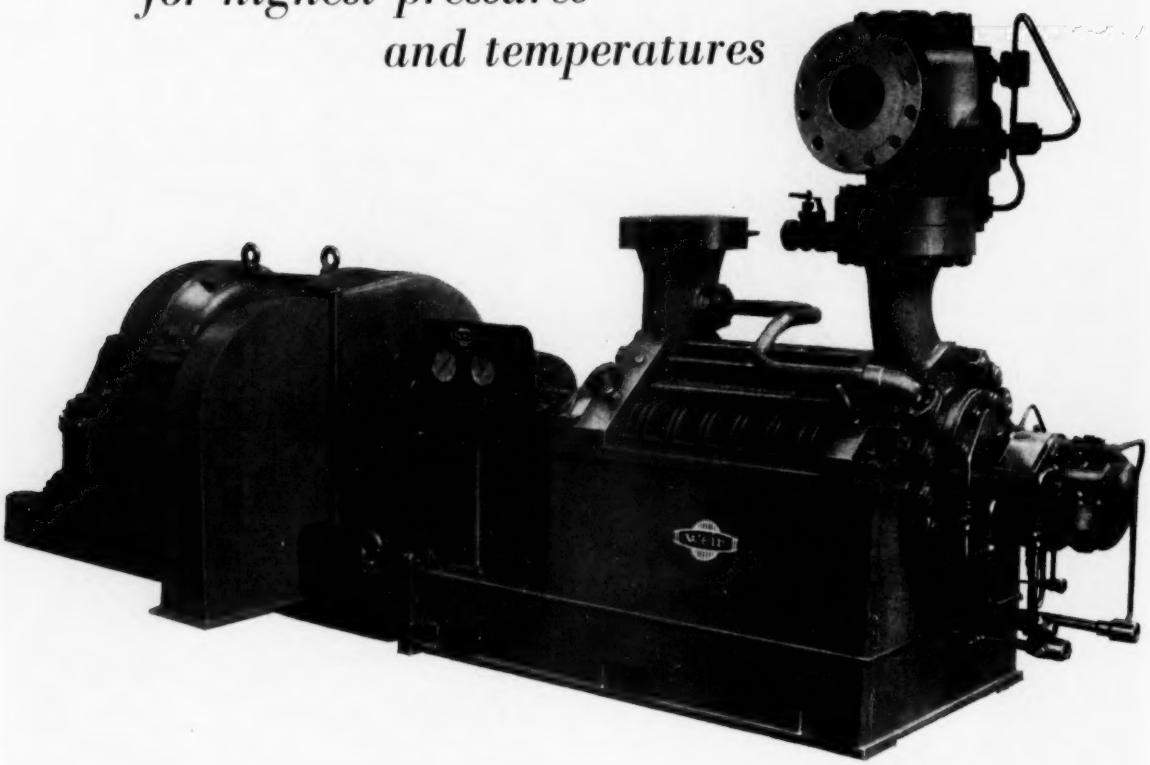

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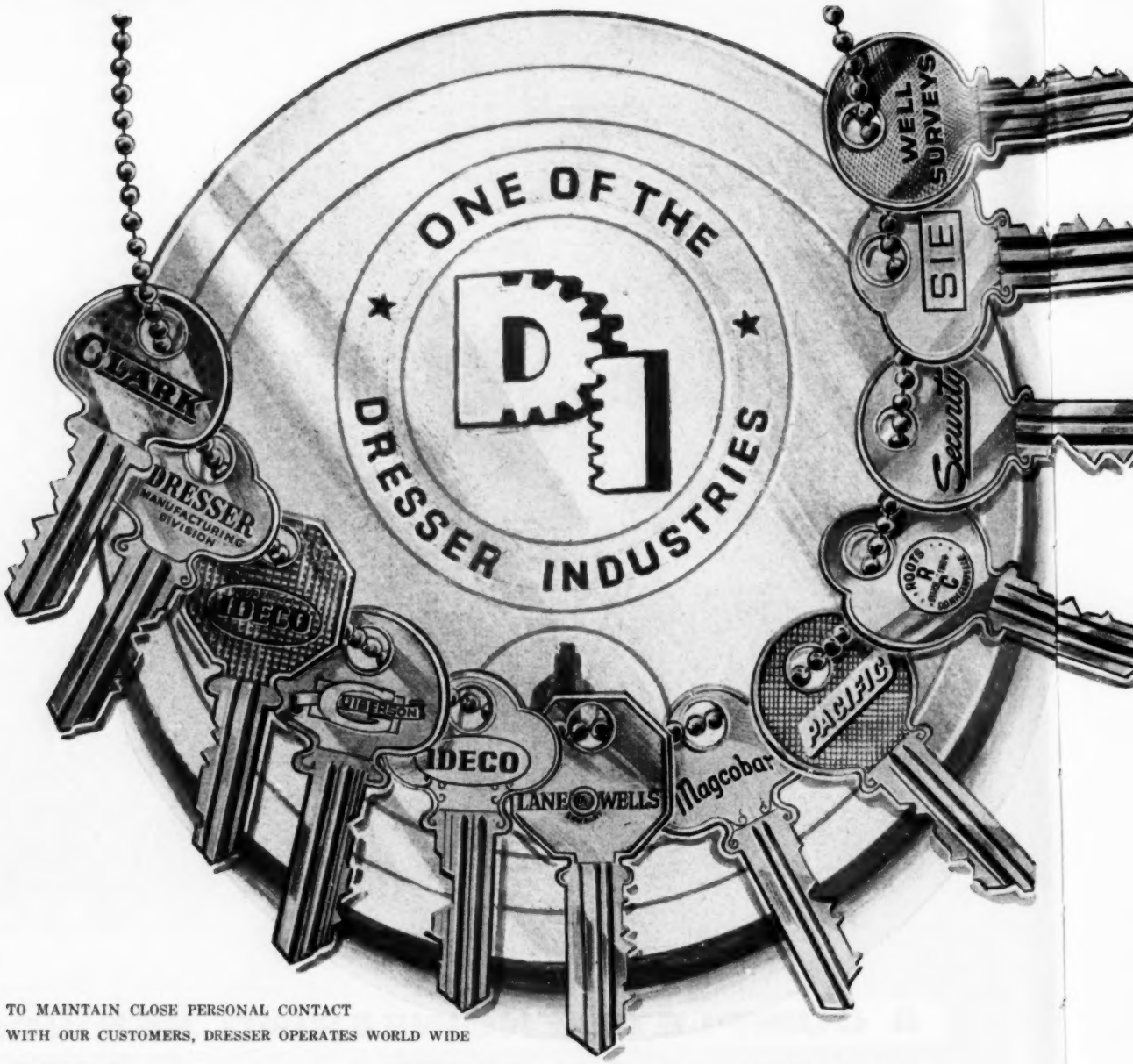

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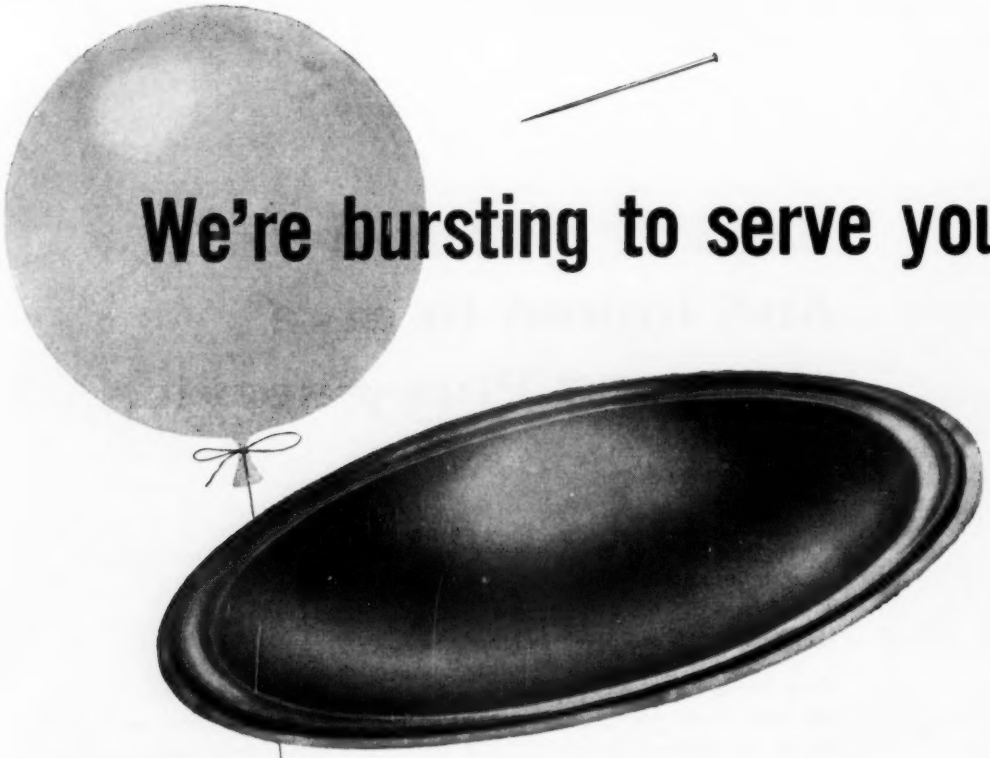

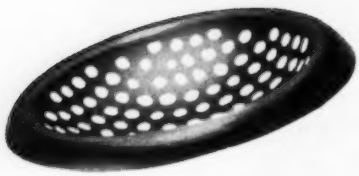

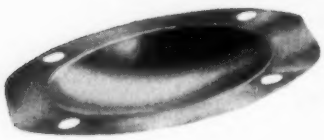

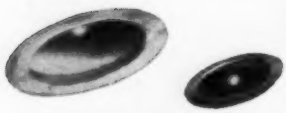

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MAR203

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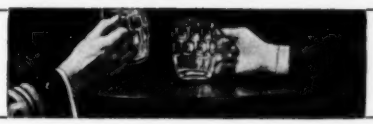
Let's sit down and talk about cricket, the weather... anything so long as it isn't your confounded Simmonds Fram Separators.

Sorry old man... didn't mean to bore you.

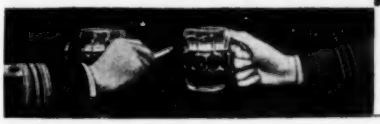


That's quite all right. Delighted to know the R.A.F. is getting up to date. So you actually fly your planes on kerosene now instead of water!

Very comical! Anyway, it's not the whole point. I admit the main object of Simmonds Fram Separators is to remove all the water, but they also take out the solids.

Little strips of erk, for instance?

... Anything down to 5 microns.



That gives me a big kick.
Which is more than I can say for this brew...

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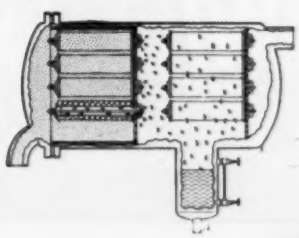

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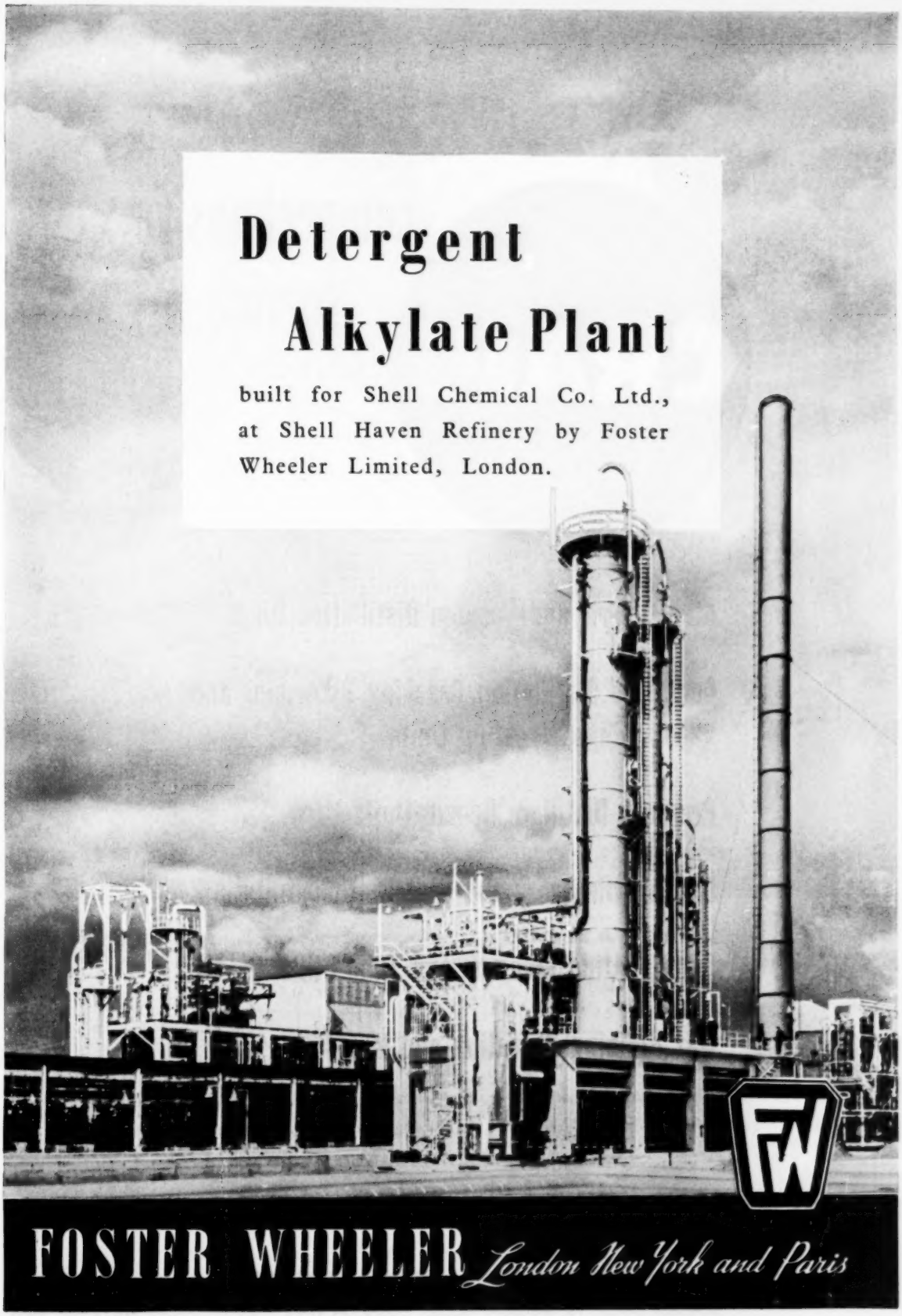
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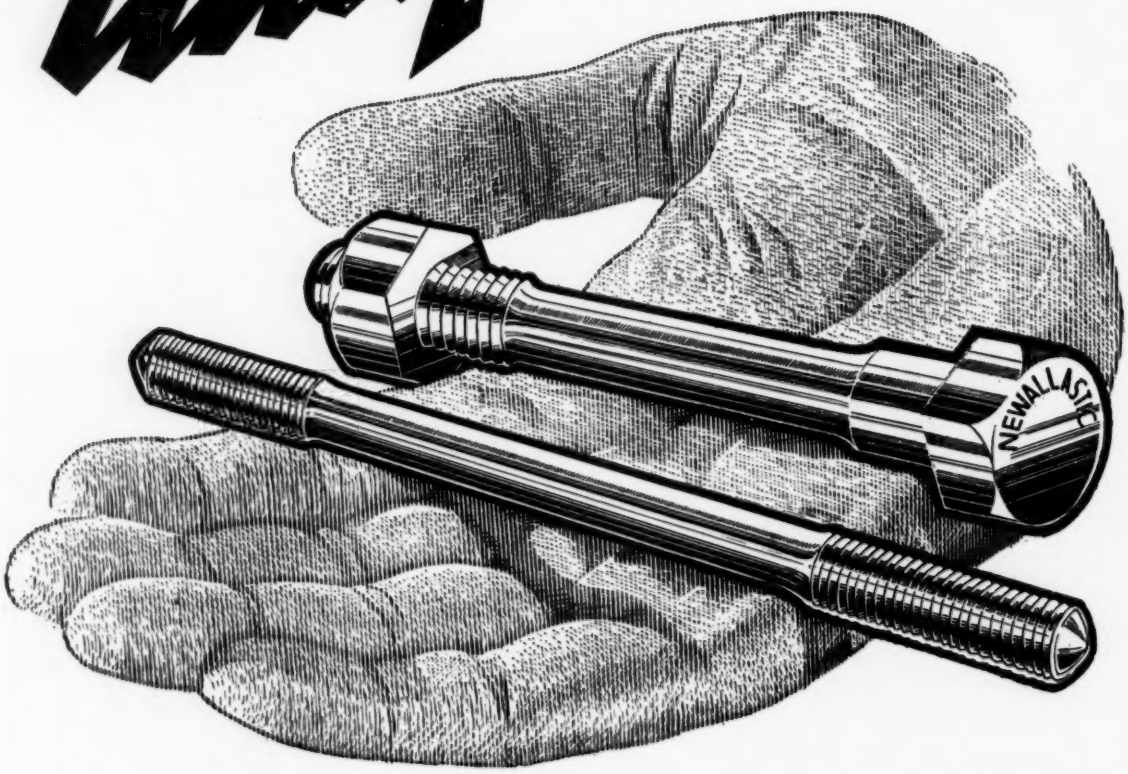

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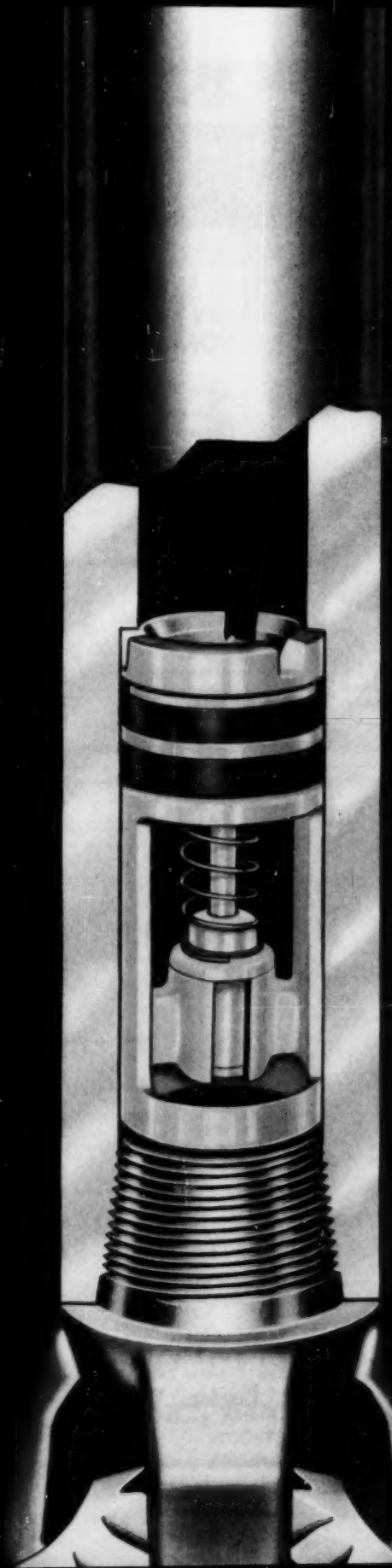

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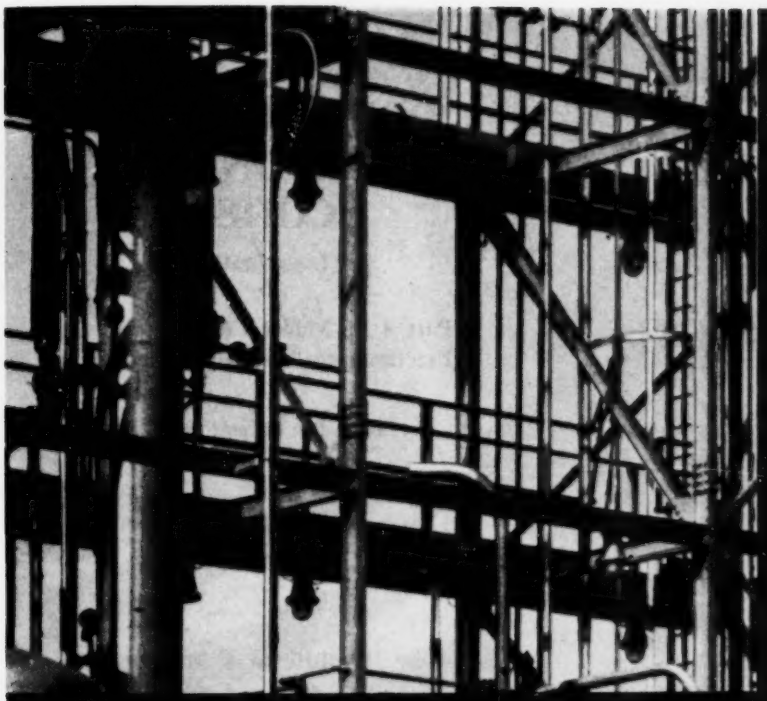

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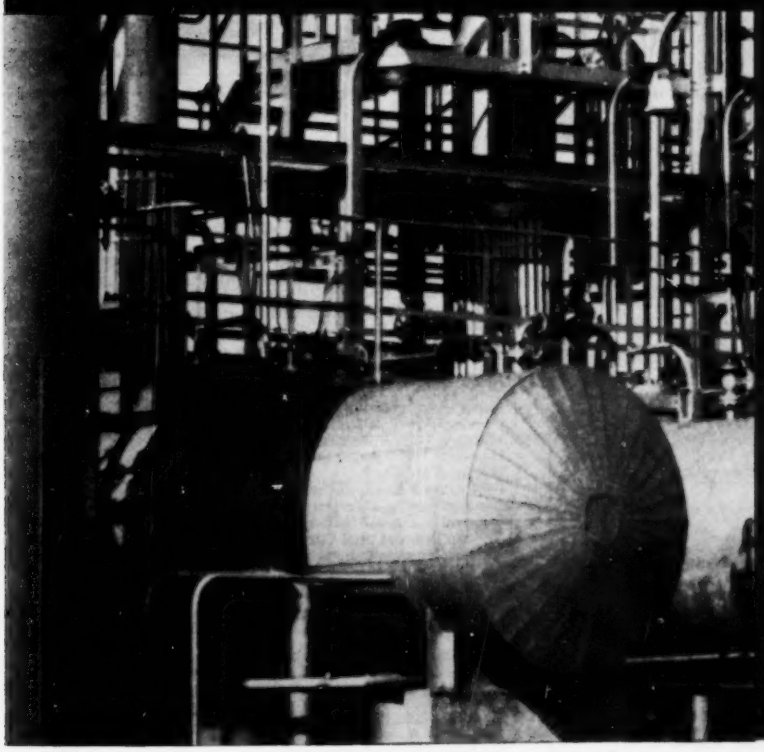

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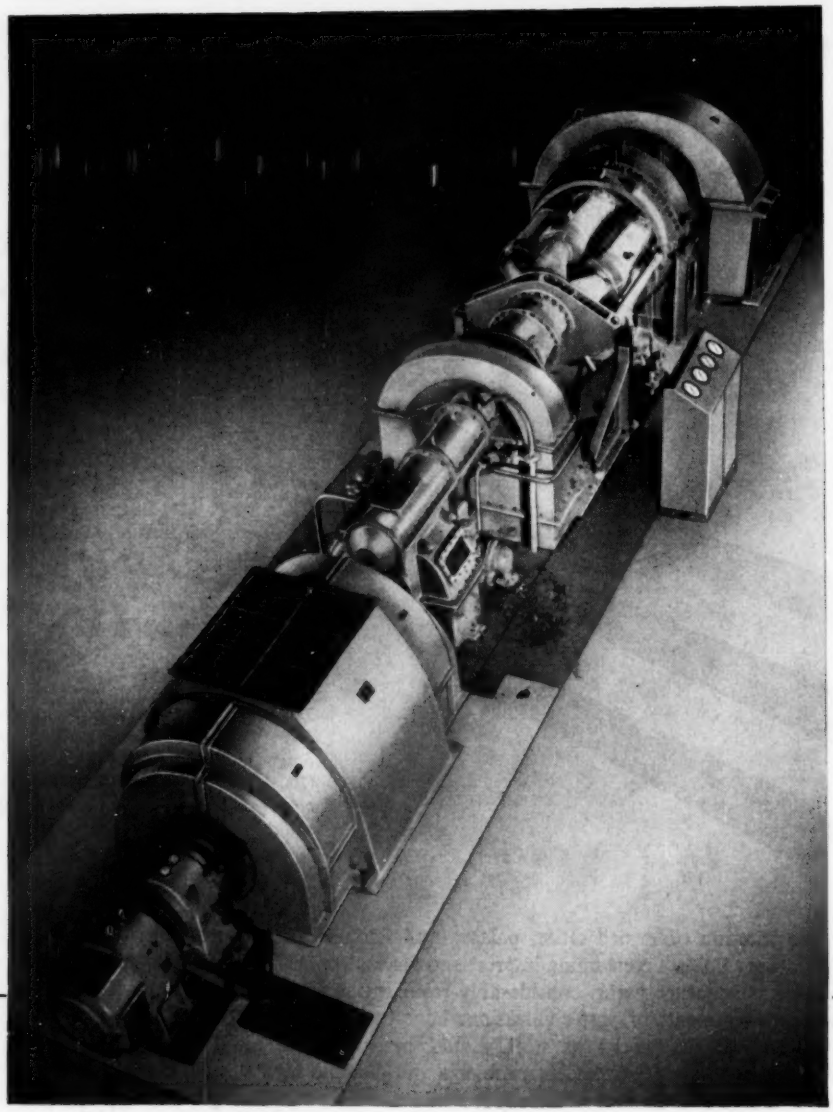

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1. Mountain-building chronology and nature of geologic time scale. E. M. Spieker. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1769–1815.—This is the substance of an address given under the auspices of the Distinguished Lecture Committee of the A.A.P.G. in Nov–Dec 1950 and Jan–Feb 1952. In this address the author discussed certain aspects of general principle in the determination and interpretation of orogenic dates; reviewed some of the critical evidence on the matter that has been found in the transition zone between the Colorado Plateaux and the Great Basin in Utah; and finally offered a few remarks on the basic nature of the time scale on which geologists plot these and other events of earth history. The author in particular queried the significance of breaks in stratigraphic sections and asked what relation stratigraphic divisions in general bear to the time scale. What is the actual nature of the time scale itself? He pointed out that many of the commonly held ideas of time breaks in stratigraphic sections in different parts of the world were based on false premises. E. N. T.

2. Terrestrial heat-flow in Hungary. T. Boldizsár. *Nature, Lond.*, 1956, **178**, 35.—Measurements were made in shafts at depths of 550–600 m, at a distance apart of 90 m. The mean value is $3{\cdot}03 \times 10^{-6}$ cal/cm²sec. At depth 570 m the virgin rock temp is 36° C, and it is thought that at 1000 m the temp may rise to 60° C. H. C. E.

3. Heat-flow from the Earth at Cambridge. P. Chadwick. *Nature, Lond.*, 1956, **178**, 105.—The heat-flow in the Palæo-

zoic rock at depth 450–860 ft was found to be $1{\cdot}28 \times 10^{-6}$ cal/cm²sec with rock temp rising from 14·5° to 16° C.
H. C. E.

4. Review of Quaternary surface formations of Gulf Coast region. J. A. Doering. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1816–62.—In the Gulf Coast region of the U.S.A., a large area is covered by a series of Quaternary surface formations. This series has been the subject of numerous geological studies over a considerable period of time, but although the general geology of the series follows a fairly simple pattern, at present the nomenclature, correlation, and mapping of its members are in a state of some confusion.

In this paper an interpretation of the series throughout the region is presented. This general view of the subject causes many of the conflicts and much of the confusion now contained in the literature to disappear. A basis is provided for some plausible speculations about the correlation of the Gulf Coast Quaternary with the Quaternary of the Atlantic Coast region and of the glaciated areas of the N. Interior. E. N. T.

5. General geology and historical development, Texas and Oklahoma Panhandles. R. B. Totten. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1945–67.—The Texas Panhandle consists of 32 counties bounded on the S. by the S. lines of Bailey, Lamb, Hale, Floyd, Motley, and Cottle counties; and the Oklahoma Panhandle includes Cimarron, Texas, and Beaver counties, the 3 most W. counties in the state.

Since 1949, when the first pre-Pennsylvanian oil was produced in the Panhandles, there has been a gradual increase in exploratory drilling, reaching boom proportions in the significant wildcat campaign of early 1956.

Major structural basins include the W. Anadarko basin, the connecting Hugoton embayment, and the Dalhart, Palo Duro, Hardeman, and Hollis (Harmon) basins.

Some of the more important positive or uplift areas are the buried Amarillo mountains or Amarillo uplift, the Matador archipelago, the Cimarron uplift, Bravo "dome," Hall County anticline, Childress anticline, and the Narcisso structure.

For more than 20 years, until 1943, there were no new discoveries in the Panhandles; most of them are in Beaver and Texas counties, Oklahoma, and in Hansford, Ochiltree, Hutchinson, and Roberts counties, Texas. Several of these fields have multipays, and one, the Quinduno field (Roberts County), has rather extensive Wolfcamp "Brown dolomite" production.

The rate of successful new-field wildcats in the Panhandles for the past 2 or 3 years is much higher than the U.S. national success average of *ca* 11%. The success ratio in an active part of the W. Anadarko basin for 1954 and 1955 is slightly below 50%. The overall success ratio for the entire Panhandle area in the same period is *ca* 25%. Consequently, it appears reasonable to forecast a continued optimistic rate of successful new-field wildcat completions in the Oklahoma and Texas Panhandles. E. N. T.

6. Heath–Amsden strata in Central Montana. P. A. Mundt. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1915–34.—The subject of this paper is the stratigraphy of those rocks of Central Montana which are present between the Ellis group of Jurassic age and the Madison group of Mississippian age. The purpose of this study includes clarification of stratigraphic relationships, correlation between outcrops and well sections, and extension and application, where possible, of new interpretations to unsolved problems in the Williston basin.
E. N. T.

7. Arizona . . . boom or bust? C. W. Swapp. *World Oil*, 1956, **143** (1), 80.—Oil and gas possibilities of Arizona are assessed. The most promising part is the N. ¼ of the state, covering *ca* 40,000 sq. miles, in which only 18 wells have been drilled. 3 of these were completed recently as oil or gas wells. C. A. F.

8. Arroyo Penasco formation, Mississippian, North-Central New Mexico. J. P. Fitzsimmons, A. K. Armstrong, and M. Gordon, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1935–44.—Although a few geologists have suspected that Mississippian rocks occur in N. Central New Mexico, no conclusive evidence has yet been discovered to warrant widespread acceptance of such a possibility. The discovery of fossil-bearing cherty limestone of Mississippian age in the Nacimiento and San Pedro mountains of N. Central New Mexico indicates a greater extent of Mississippian marine invasion than has heretofore been widely accepted. This paper describes the first important discovery of pre-Pennsylvanian megafossils in N. New Mexico in an area extending 200 miles from the Ladron Mountains to the Piedra River Canyon of S. Colorado. The most complete section observed, and the best fossil locality, is in Arroyo Penasco in the San Ysidro Quadrangle, New Mexico. It is proposed that the formation be called the Arroyo Penasco formation.
E. N. T.

9. Pitchfork formation, detrital facies of Early Basic Breccia, Absaroka Range, Wyoming. R. L. Hay. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1863–98.—This report is chiefly a mineralogic, textural, and stratigraphic study of Middle Eocene detrital volcanic deposits in the Absaroka Range along the W. margin of the Bighorn basin, Wyoming. The present study was specifically undertaken to solve stratigraphic discrepancies between the Bighorn and Wind River basins, and several correlations are suggested. This study is also an illustration of the stratigraphic and mineralogic complexity which characterizes many detrital volcanic deposits.

The Pitchfork formation is here defined as the lowest series of beds in the SE. part of the Absaroka Range, Wyoming. The Pitchfork formation consists largely of detrital rocks, sandstones, siltstones, and conglomerates—containing volcanic debris from eruptive centres in the Yellowstone Park–Absaroka volcanic province. The thickness of the Pitchfork formation ranges from *ca* 200 to *ca* 1200 ft, and is generally *ca* 1000 ft. E. N. T.

10. New geologic formation names in Jackson Hole, Teton County, Northwestern Wyoming. J. D. Love. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1899–1914.—The stratigraphy and structure of the Jackson Hole region, Teton County, NW. Wyoming, were studied during a number of field seasons between 1945 and 1955. The results of various phases of this investigation have been presented in a number of papers. The author now gives sufficient data on 4 of the previously provisionally named formations to warrant application of formal names; these are the Harebell formation, Colter formation, the Teewinot formation, and the Bivouac formation, which are here defined in each case. E. N. T.

11. Upper Cretaceous rocks of parts of Southwestern Oregon and Northern California. D. L. Peck, R. W. Imlay, and W. P. Popenoe. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (8), 1968–84.—The Upper Cretaceous rocks in Siskiyou County, California, and in adjoining Jackson County, Oregon, are herein defined as the Hornbrook formation. A new name to differentiate them from the Chico formation in California is justified by their remote position and by their nearly complete lack of fauna in common with the Chico at its type section. The Hornbrook formation comprises at least 2500 ft of arkosic wacke sandstone, siltstone, mudstone, and conglomerate; contains fossils of Cenomanian, Turonian, and Campanian age; and includes one unconformity. E. N. T.

12. Southern Saskatchewan makes big plans. P. F. Brennan and R. R. Graves. *Oil Gas J.*, 20.8.56, **54** (68), 156.—The regional geology and the field geology of the N. part of the Williston basin in S. Saskatchewan are described. Most of the Mississippian discoveries of the area have been found on

the NE. flank of the basin, where the regional dip is greatest. The Mississippian is divided into the Bakken (base), Lodgepole, Mission Canyon, and Charles. The Bakken is mainly clastic and is locally productive. The other formations are mainly carbonate and comprise the Madison group. The Lodgepole has not been found productive in Saskatchewan, although it produces high-gravity oil in Manitoba. The Mission Canyon is the most important producing formation of the area, and the Charles is important for production in the SE. part.

All the Mississippian fields are believed to be stratigraphic traps, due to porosity development in limestones. They occur in 2 well-defined beds trending NW.–SE. C. A. F.

13. Savanna Creek may rival Pincher Creek. J. S. Irwin. *Oil Gas J.*, 20.8.56, **54** (68), 149.—The geology and development of the Savanna Creek field in the Rocky Mountains, 60 miles SW. of Calgary, Alberta, are briefly described. Gas was first found in 1955, and a second well has also found gas. As it is estimated that there is over one trillion cu. ft. of disposable gas between 7200 and 8300 ft in the Mississippian Rundle limestone, further exploration is warranted, although it will be slow and costly. The structure is shown as an anticline at surface consisting of a folded overthrust fault plate composed of Pennsylvanian and Mississippian rocks. This overlies a second fault plate 5100 ft thick composed of Cretaceous, Jurassic, and Upper Mississippian, and production is obtained from porous zones in the limestone beneath the bottom overthrust. C. A. F.

14. SCP finds 5 new oil areas in Morocco during 1955. M. Moyal. *World Oil*, 1956, **143** (1), 176.—5 new discoveries or extensions were found in Morocco during 1955. These are as follows: wells KH 21 and 22 found oil in the Mesozoic NW. of Upper Bled Khatana; KH 25 on the E. side of Primary Bled Khatana found a new pool, and further development of Palæozoic and Mesozoic pools is expected; ZR 6 near the E. side of Lower Bled Khatana found pay in fractured granite at 5600 ft; ZR 11 near ZR 6 found a new pool in the Mesozoic at the base of the Sidi Fili fault; and BD 129 on the Djebel Bou Draa found oil in the Domerian at 2100 ft. 39 wells were drilled in Morocco in 1955, 16 of which were exploratory tests. A map shows geologically favourable areas in the country. C. A. F.

15. Oil show raises Nigerian hopes. Anon. *Oil Gas J.*, 27.8.56, **54** (69), 80.—1 Oloibiri, E. of Port Harcourt in Nigeria, is reported to have had a good show of free oil. The wildcat is 12,000 ft deep and is the eleventh to be drilled over a period of 18 years. Some of these have had shows, but none were of commercial value. C. A. F.

16. Karamai: China's biggest oilfield. Anon. *Oil Gas J.*, 13.8.56, **54** (67), 102—A new oilfield, claimed the largest in the country, has been reported in China. It is near Karamai in the Tzungaria basin of N. Sinkiang. 10 producing wells are reported. The field is in the same region as the Tushantzu field, which in 1943 was producing 300 b.d. from 4 wells. Exploration is to be carried out in the Gobi Desert. C. A. F.

17. 3rd Mobil Portugal test readied; No. 2 abandoned. Anon. *World Oil*, 1956, **143** (1), 188.—A second exploratory well, Arruda 1, near Vila Franca de Xira, *ca* 30 miles N. of Lisbon, has been abandoned at a total depth of 7009 ft. A third well is to be drilled at Barreiro *ca* 6 miles from Lisbon. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

18. Improvements in seismic prospecting. Anon. *Nature, Lond.*, 1956, **177**, 1209.—Report of a discussion of the Royal Astronomical Society in London, April 1956.

A continuous velocity logger has been developed. This consists of an ultrasonic pulse generator and receiver suspended by a cable and separated by a length of acoustic insulator. The times of transmission and reception of the pulses are recorded; and the time delay, recorded as a function of depth, is a direct measure of the seismic velocity in the materials forming the borehole walls. The instrument reveals many hitherto unsuspected discontinuities, and is not seriously affected by saline drilling fluids. It would appear that when velocity logging is used in conjunction with electrical logging it may be possible to differentiate between the presence of gas, oil, and water.

Another paper describes seismic refraction methods for giving a picture of velocity variations in lateral and vertical directions and for revealing sub-surface structural features under conditions where the velocity contrast is <2000 ft/sec. The aim of the method is to convert the time–distance curve into a time section, *i.e.* one in which the vertical scale gives the delay time of a point on the refractor below the datum; this is achieved by producing the half-intercept time profiles. From the latter a depth profile for each refractor can be obtained. Complications appear where the lateral velocity variation along a refractor approaches the variation in a vertical direction. H. C. E.

19. Reefs are hard to find. R. A. Pohly. *World Oil*, 1956, **143** (1), 75.—Gravity methods of exploration are recommended for the search for reef structures in the Appalachian area of the U.S.A. In recent years *ca* 40 reefs have been found in Indiana, Illinois, Michigan, and Ontario by drilling on gravity anomalies. These are usually pinnacle bioherms in the Niagara formation, and they produce in several states. The reef core is a mass of limestone or dolomite with low density at the top due to high porosity but high density at the base due to secondary filling of the pores. The net effect is a gravity max. C. A. F.

20. Gravity—an accurate exploration tool. W. F. Stackler. *Oil Gas J.*, 20.8.56, **54** (68), 210.—Gravity exploration is a useful tool in exploring the Rocky Mountain foothills area of W. Canada in spite of complex topography and density distribution at the surface. Ways of minimizing these difficulties are briefly described. Important reductions which must be made are for the Bouger and terrain effects. 2 refs. C. A. F.

21. Andean slope is surveyed. Anon. *Oil Gas J.*, 27.8.56, **54** (69), 79.—An airborne magnetometer survey is being made of 23,338 sq. miles of the E. slope of the Andes Mountains in Peru. This follows an air photo survey of the area carried out over 2 years ago. C. A. F.

DRILLING

22. Directional drilling for salt dome oil production. K. R. Joynt and A. H. Massad. *World Oil*, 1956, **142** (7), 192.—Directional drilling has become a development technique in the drilling of salt dome fields in the Gulf of Mexico. 2 basic methods are used, dependent on structure, location of target in relation to surface location, casing programme, spacing requirements, and limitations of equipment. In the first method the drift angle is increased at a constant rate to the desired max deflection, which is then held until the target is reached, and in the second the drift angle is increased at a uniform rate until the required lateral displacement is obtained; at this point the well is returned to vertical at a uniform rate of decrease of angle, and drilling continues vertical to the target. It has been found that on a deep-seated dome only the constant angle or " on-course " method is required, but in development work on piercement domes both methods are used. C. A. F.

23. New oil emulsion speeds West Texas drilling. E. McGhee. *Oil Gas J.*, 13.8.56, **54** (67), 110.—The use of an oil–water emulsion drilling fluid in W. Texas is described. Its main advantage is in increasing the life of bits so that overall drilling time is reduced. Cuttings are good and fall out quickly at the surface, and diesel and crude oil have been used as ingredients. C. A. F.

24. Gulf Coast drilling mud practices demand attention to special problems. G. R. Gray, G. G. Allen, and N. K. Tschirley. *World Oil*, 1956, **142** (7), 155.—Successful deep drilling in the Gulf Coast requires careful planning of the mud programme. The increase in average depth of the wells in this area is due to continuous improvement in this respect.

The main problems affecting mud programmes are discussed. Most drilling involves penetration of thick shale beds, and there may be mud thickening and sticking of tools due to sloughing. This problem can be overcome by chemical treatment and by using calcium surfactant mud, as well as by other means. High pressures in excess of the " normal " gradient of 46·5 p.s.i/100 ft are common and can be withstood by increasing mud weight and careful drilling. Loss of circulation has been combated in many ways, such as the use of aerated salt water as a circulating medium, followed by the addition of a surfactant, and various bridging and plugging materials have been employed. Difficulties caused by increased gelation at high temp can be avoided by mechanical removal of the clays. Special mud programmes are required for salt dome drilling and in offshore work. C. A. F.

25. Careful study of reports revealed how to get best results from diamond coring. A. G. G. de Chastelain. *Oil Gas J.*, 20.8.56, **54** (68), 132.—A study of diamond coring reports between Jan 1952 and June 1955 has shown that weight on bit is the most important variable in coring operations, whereas changes in rotary-table speed have little effect on penetration rates. C. A. F.

26. You can reduce lost-circulation problems. Pt 2. E. H. Clark. *Oil Gas J.*, 16.7.56, **54** (63), 112.—Although most cases of lost circulation occur whilst drilling open hole, problems may arise when floating casing, due to the danger of creating very high pressure surges. This is particularly hazardous when: (1) large numbers of centralizers and scratchers are used; (2) where there is inadequate control of pipe handling; (3) when using heavier muds; and (4) where there are small annular clearances. These points are illustrated in descriptions of a normal cementation job and a theoretical lost-circulation job. Ways of combating lost circulation are indicated. 7 refs. C. A. F.

27. Fishing operations in Venezuela. R. W. Beck. *Petrol. Engr*, 1956, **28** (4), B95.—A statistical study of fishing operations during the last 7½ years by Creole in Venezuela has shown that recent improvements in reducing fishing time are due to increased use of oil-emulsion muds, the replacement of over-age and worn out drill collars, and the results of drilling training programmes. The data for the study was collected and shown as incidence of fishing jobs/rig-year and severity in terms of average days/job. Rate of fishing jobs has varied only slightly from an average of 5·7 jobs/rig-year, but the severity ranged from 1·3 days/job in 1955 to a max of 7·5 days/job in 1951. Relative amount of time spent on fishing operations ranged from 7·9% of all rig time in 1953 to 2·1% in 1955. C. A. F.

PRODUCTION

28. Water flood ups production twelvefold. A. C. Simmons. *Oil Gas J.*, 27.8.56, **54** (69), 90.—Water flooding has proved successful in the Oil Springs area of Magoffin County, Kentucky. Pay is Mississippian Weir sand, which has been producing since 1919. The fields of the area have a total producing area of 6700 acres with a primary oil recovery estimated at only 80 brl/acre-ft. Following a pilot flood in 1951, a second flood was started, and there has been a substantial production increase since 1954. The area was previously considered a poor prospect for flooding because of low oil saturation and high water saturation. C. A. F.

29. Five-spot water-flood unit ups production 38,000 brl. W. M. Edinger. *Oil Gas J.*, 27.8.56, **54** (69), 82.—Water-flood operations in the NW. Tyron field, Lincoln County, Oklahoma, are described. The field was found in 1949, and pay is Pennsylvanian Red Fork sand at 4100 ft. It was unitized in 1953, and water flooding was developed on a basic 40-acre, 5-spot pattern. The distribution system consists of 3 main headers, which include pressure gauge, nutating type water meter, and check valves. Before flooding, production had fallen to 4102 brl/month, and this has now increased to 39,273 brl/month (March 1956). Operating costs are approx 13 cents/brl. A table showing reservoir data is included. C. A. F.

30. Calculating reserves in deposits. K. Brüning. *Erdöl u. Kohle*, 1956, **9**, 150–2.—For estimating reserves in petroleum deposits 2 processes—volumetric and pressure fall—are available; both are subject to considerable error. A method, given for the pressure fall procedure, provides for eliminating the error caused by boundary H_2O expansion, assuming that decrease in gas vol during yielding is a linear function of the pressure. R. T.

31. Fluid fracturing boosts Manitoba activity. H. Weiner. *Oil Gas J.*, 20.8.56, **54** (68), 142.—Oil was first found in commercial quantities in Manitoba in 1951, but there was little development until the introduction of fracturing techniques in 1954 and 1955. All the production comes from low permeability Mississippian limestones, and most of the fields are in the Daly and Virden areas, where pays are between 2000 and 3000 ft. Drilling techniques, testing and treating procedures, and pay lithology in each of these areas are described briefly. In the Daly area the best fracture treatment for a well is *ca* 10,000 lb of sand, mixed in oil at 1–3 lb/gal. C. A. F.

32. Louisiana's Pine Island Chalk Rock proving ground. C. R. Jordan. *World Oil*, 1956, **142** (7), 240.—Modern methods of primary and secondary recovery have increased production and reserves of the Annona chalk in the Pine Island field, N. Louisiana. Hydrafrac treatment has now been discontinued, and sand–oil treatments are now used to boost production. High visc, low-gravity oil is mixed with rounded sand and pumped into the well at high velocity. Zones are selected for treatment from γ-ray and neutron logs. C. A. F.

33. Here's how to stress relieve in the field. R. E. Cannon. *Petrol. Process.*, 1956, **11** (6), 74–5.—Vessels, pipe fittings, etc., can be easily stress relieved *in situ* with just normal material and equipment without the necessity of transporting units to furnaces—impossible with large vessels. Today's most widely used technique is resistance heating done by welding machines. Although not a complicated process, knowledge of technique is required to avoid damaging of expensive machines and improper heat control leading to increased stress in the metal, embrittlement, or case-hardening. J. H.

OILFIELD DEVELOPMENT

34. Pierce Junction is hottest spot on Texas Gulf Coast. C. Hoppins. *World Oil*, 1956, **142** (7), 205.—The very rapid development during the last 2 years of the Pierce Junction salt dome field near Houston, Texas, is described. In Sept 1954 the field was producing 77,971 brl from 92 pumping and

9 flowing wells, and in March 1956 this increased to 285,971 brl from 84 pumping and 75 flowing wells. Before 1954, drilling was sporadic, being confined mainly to Miocene and Frio reservoirs, and intensive development started only with the discovery of Vicksburg pays on the E. flank late in 1954. Early history of the field is outlined. C. A. F.

35. Quebec adds oil and gas to vast mineral resources. E. Fancott. *Oil Gas J.*, 20.8.56, **54** (68), 280.—The history of the search for oil in the lowlands of Quebec and the results of recent exploration are outlined. The area is underlain by Ordovician and Cambrian rocks folded into a broad syncline trending NE., and suitable traps are indicated. The sediments are mainly limestones and dolomites, with subordinate shales and sandstones. Gas has been known for many years, but the search for oil has been unsuccessful. In 1955 several test wells found commercial gas, and further drilling is planned. Gravity and seismic work has been completed over an area of ½ million acres. C. A. F.

36. Saskatchewan's Dollard field profits from a plan of pressure maintenance by water flood. W. E. Perkes. *Oil Gas J.*, 20.8.56, **54** (68), 136.—Water flood operations in the Dollard field, Saskatchewan, are described. The field was discovered in 1953, and pay is a Jurassic sand producing 23° oil. Development was on 160-acre spacing, and 52 wells were drilled before water flooding was initiated in March 1956; performance has so far been satisfactory.

The reservoir is a closed stratigraphic trap at a depth of *ca* 4500 ft. Max net pay thickness is 44 ft.

Reservoir data are given, and charts show production history, pay isopachs, and progressive pressure depletion. C. A. F.

37. Arctic hunt pushed. Anon. *Oil Gas J.*, 27.8.56, **54** (69), 77.—Drilling has been resumed at the Norman Wells field in the NW. Territories of Canada. The field was found in 1920, and 4 development wells are now being drilled to serve the local refinery. Field production in 1955 was 404,219 brl. 80 wells have been drilled in the field. C. A. F.

38. Petroleum developments in Mexico in 1955. E. J. Guzman and F. Mina U. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (7), 1485–97.—The most significant discoveries in petroleum exploration in Mexico during 1955 continued to be made in the Tampico embayment, where production is obtained from Albian–Cenomanian (Middle Cretaceous) limestones. In the same area Eocene sand production is gradually increasing in importance. 9 new oilfields were discovered in the Tampico region. Statistics gathered by Petroleos Mexicanos show that the 330 wells drilled in Mexico in the search for oil and gas in 1955 represent an increase of 12·6% over the 293 wells drilled in 1954. The total footage for 1955 was 1,790,260 ft, which was an all-time max for Mexico. 114 wells were exploratory tests, and 46 were completed as producers, resulting in the discovery of 15 new oil or gas fields, 22 new pools, and 9 extensions to previously-known production. The total amount of crude oil and dist production for 1955 amounted to 91,248,161 brl, an increase of 7·1% over the 1954 total. The total gas production was 191,771,106 M.c.f.

Exploration was carried on by 381 party-months of geological and geophysical work, concentrated mostly in the known coastal plain provinces bordering the Gulf of Mexico. Gravity-meter reconnaissance was continued in Yucatan and renewed in the Lower California Peninsula. Stratigraphic exploration drilling was continued with the drilling of another deep well in Lower California. E. N. T.

39. Petroleum developments in South America and Caribbean area in 1955. W. F. Effinger. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (7), 1498–1542.—Oil production continued to rise in all S. American countries except Colombia, where a very slight decline was reported during 1955. The total 1955 production from S. America and Trinidad totalled 911,237,125 brl, which represented an increase of 12½% over the previous year's figure. The greatest increases in the amount of oil produced were in Venezuela, which recorded an increase of 95,791,932 brl, and Trinidad with an increase of 1,268,000 brl. The greatest percentage increases were in Brazil with 104% and Bolivia with 59% increases respectively.

The paper summarizes the statistical data regarding production from each of the S. American oil-producing countries. The most significant developments in this region during 1955 were as follows:

Argentina.—The overthrow of the Peron Government and reversion to a strongly nationalistic policy in the development of that country's oil resources.

Bolivia.—The passage of a new Bolivian petroleum law designed to invite private participation in the country's oil development, and the continued steady rise of the country's rate of oil production.

Brazil.—The year marked the first notable discovery of oil in the Amazon basin, which is the first real encouragement outside the presently productive Reconcavo basin.

Cuba.—The continued very active exploration for oil within the country.

Guatemala.—The formulation of a new oil law inviting private participation in oil exploration and the very active interest, as evidenced by the large number of applications for concessions.

Venezuela.—Strong indications were that the Venezuelan Government would throw open new lands for oil and gas concessions after a 10-year period of withholding new concessions. E. N. T.

40. Petroleum developments in Africa in 1955. H. D. Hedberg. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (7), 1582–1632.—The total cumulative production of crude oil from the African continent has now reached 235 million brl. However, the annual production continued to decline in 1955, being only 13,944,527 brl, as compared with a peak figure of 17,000,000 brl in 1953. There are still only 3 countries with a commercial production (Algeria, Egypt, and Morocco), and each of these showed a decline in 1955. In spite of this decline in production, exploration activity continued to increase, and petroleum exploration was carried on in 24 African countries during the year. The most important developments are summarized as follows:

In the Algerian Sahara, 12 drilling rigs and 18 geophysical parties were operating at the end of the year. 22 wildcats were completed in Algeria during the year at an average depth of *ca* 5800 ft. A substantial gas discovery was made at Djebel Foua in the Est-Constantinois, and early in 1956 a CREPS well near the Libyan frontier is reported to have tested 400 b.d. from a depth of 1475 ft.

In Angola, Purfina discovered potentially commercial production in its Benfica-2 well S. of Luanda in Lower Cretaceous limestone. This well is reported to have tested 360 b.d. of 20°–30° API-gravity oil.

In the Belgian Congo, exploratory drilling for oil was begun.

In the French Cameroons, the Logbaba-101 well blew out with gas and dist and flowed out of control for 40 days at an estimated rate of 30 million cu. ft/day. The Suellaba-2 well tested oil from 3 sands, one of which is reported to have flowed at a rate of 40 brl/hr.

In Egypt, the Belayim field was discovered by the International Egyptian Oil Co, and a first wildcat (dry) was drilled on the large Sahara Petroleum Co concession in NW. Egypt, where extensive geological and geophysical operations are in progress.

In French Equatorial Africa, in the vicinity of Port Gentil,

2 1955 wildcats yielded small quantities of 20°-gravity oil, and early in 1956 the OZ-1 well 20 miles ESE. of Port Gentil tested at the rate of 140 b.d. of 25° oil.

Libya enacted a petroleum law. 15 companies have applied for concessions, and geological and geophysical exploration work is active.

Exploration and drilling continued in Nigeria at a high level. High-pressure gas was encountered at Akukwa, and promising oil tests were obtained at Oloibiri.

Drilling was started in N. Somalia, and preparations for drilling were under way in E. Central Somalia.

The first deep well in Tanganyika was completed as a dry hole on Mafia Island.

Extensive exploration work was also carried out in Senegal, Ethiopia, Madagascar, Morocco, Mozambique, and Tunisia. E. N. T.

41. Petroleum developments in Middle East and adjacent countries in 1955. W. E. Heater. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (7), 1633–56.—Petroleum production in the Middle East countries in 1955 totalled 1,183,951,800 brl, which was for the first time a total in excess of one billion (U.S.) brl and showed a marked increase over the 998,804,700 brl produced in 1954.

Production in India and Pakistan in 1955 was 4,594,000 brl, an average of 12,590 b.d. as compared with 11,460 b.d. in 1954.

The Jambur field, in the NE. part of Iraq, was put on production for export in Dec 1955.

An apparently important oil discovery was made in the N. part of Kuwait, where the wildcat well Raudhatain No. 1 was successfully completed at a depth of 10,301 ft. The first production of oil in Israel was obtained upon completion of the Heletz No. 1 test at the total depth of 4969 ft. A gas reservoir which may be of considerable size was discovered at Uch, W. of the Sui gas field, in W. Pakistan.

Geological and/or geophysical work was carried out in varying degrees of intensity in the countries covered by this review, except in Iran, Kuwait–Saudi Arabia Neutral Zone, Bahrain, Aden, Hadhramaut, Jordan, Syria, Lebanon, and Cyprus. E. N. T.

42. Petroleum developments in Far East in 1955. G. F. Kaufmann. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (7), 1657–77.—No significant change has taken place in petroleum operations or production in the Far East during 1955. They have continued to be retarded by the uncertain political situation in Indonesia and unstable political conditions in other areas.

Australia has had another disappointing year in the search for major oil production. Generally there has been little change, during 1955, in the Far East from the level of production and operations reached in 1954. The crude oil production of the Far East is estimated to have been at the average of 392,223 b.d. during 1955, as compared with 364,253 b.d. in 1954. The increase of 27,970 b.d. can be accounted for by stepped-up production in the established fields of Sumatra and British Borneo. E. N. T.

43. Petroleum developments in Europe in 1955. R. E. King. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (7), 1543–81.—Petroleum production in W. Europe excluding Austria increased 25% in 1955, or at a greater rate than in 1954, due to the placing on full production of 2 large fields discovered in previous years, Parentis in France, and Ragusa in Sicily, as well as a steady increase in production in Germany and the Netherlands. The Austrian oil industry was returned by Russia to Austrian control in Aug 1955. As Austrian production is greater than that of any other country in W. Europe, this was the chief factor in a substantial boost in daily average production in W. Europe from 87,486 brl in 1954 to 177,265 brl in 1955. W. Germany was the second most important producing country, but in spite of intensified drilling and exploration, German reserves showed only a modest increase. One of the most significant new developments of the year was the discovery of oil shallower than 2000 ft in 2 fields in the Abruzzi region of Sicily. Another well in Abruzzi had good showings of low-gravity oil in the Lower Cretaceous at *ca* 10,000 ft. E. N. T.

TRANSPORT AND STORAGE

44. Evaporation losses and their control in storage. W. A. Bussard. *Petrol. Process.*, 1956, **11** (7), 103–26.—An estimate of 3% of all petroleum produced in the U.S.A. is lost by evaporation on its way from the wellhead to the consumer, amounting to 75 million brl, or $300 million p.a. This special report aims at 3 targets: (1) what is evaporation and what causes it?; (2) what types of evaporation losses confront today's petroleum processer?; and (3) what equipment and techniques can reduce these losses? Other reasons for preventing evaporation losses during storage are safety, corrosion, and possible air pollution. A comprehensive survey is made of storage tanks, the type, operating pressure, capacity, cost, "breathing" ability, use, and advantages and disadvantages, etc. Tank accessories, including valves and vents, are discussed and also such procedures as the use of microballoons, plastic blankets, and the use of vapour balances and vapour recovery techniques. A comprehensive literature survey is listed, together with a survey of the makers of various types of tanks, valves, etc. J. H.

45. World tanker fleet review. Anon. *Petrol. Times*, 14.9.56, **60** (1542), 827.—New construction, ownership, shipyards, costs, size, technical features, and future outlook are reviewed on a half-yearly analysis by John L. Jacob and Co Ltd. A summary of world fleet ownership and tonnage is given. G. A. C.

46. Oil tank interior protection. Anon. *Mot. Ship*, Sept 1956, **37** (436), 207.—A coating system for tank interior protection introduced by the Red Hand Compositions Co is reported. The surface of a tank after preparation by shot blasting or chipping, etc., is treated with a 3-coat process. Each coat is supplied with activator, this is mixed with the base when required. The first 2 coats take 3–4 hr to dry, the final coat curing takes 5 days. A continuous supply of fresh air by forced draught should be provided to the tanks during the application and drying. Advantages claimed for the system are: it is non-toxic, there is no discomfort during painting, the pigmentation of the paint is such that there is no danger of static charge formation, protection from attack by crude oil, aviation spirit, kerosine, water ballast, etc., is claimed, but other cargoes, *e.g.* edible oils, alkalis, etc., would require another of the special paints. Results of tests on commercially-operated tankers have shown the process to be satisfactory. D. K.

47. Performance of largest motor tanker. Anon. *Mot. Ship*, Sept 1956, **37** (436), 198.—The performance of the 34,800 dw tons *Ferncrest* over 58,415 miles from 19 Jan to 12 July 1956 is considered. Diesel oil was used in the main engine during this period. With the vessel loaded the main engine used 38 tons of fuel/day. The diesel-driven generators consumed 1·9 tons/day in addition, but use of the exhaust

gas boiler and turbo-generator reduced the total consumption by 0·9 tons/day to a total of 39 tons. From 12 July the vessel operated on heavy oil (sp. gr. 0·94). There was a saving in the fuel bill of £160/day, but the increased fuel consumption due to lower calorific value of fuel was not taken into account. D. K.

48. The 18,500-19,500 ton tanker. Anon. *Mot. Ship*, Sept 1956, **37** (436), 208.—The class of tanker being built in the largest numbers is that between 18,500 and 19,500 dw tons. The trends in this class of vessel are discussed. D. K.

49. Use of radioactivity and nucleonics in the oil industry. E. W. Jones and S. B. Knowlden. *Fluid Handl.*, 1956, 240–2.—Description of procedures for location in pipelines of scraper and batching pigs tagged with radio-cobalt. Batching can also be effected by injecting an oil soln of a source of radioactivity into the pipeline at the front of a new grade of oil. Detector station near terminal records radiation intensity, whence degree of intermixing of the 2 batches, and hence correct switching procedure, can be deduced. Radiation hazards and precautions are briefly considered. W. A. M.

50. Pipelines—greatest transport bargain. K. B. Barnes. *Oil Gas J.*, 17.9.56, **54** (72), 140.—The economics of transporting petroleum products in the U.S.A. is tabulated; pipelines *v.* railroad charges, tariff revenues and throughputs, and maps showing crude oil and produce pipelines to principal refining centres and from there to consumers are given. G. A. C.

51. Trans-Canadian line steaming ahead. P. Reed. *Oil Gas J.*, 17.9.56, **54** (72), 147.—A review is given of the work in Saskatchewan being carried out for the start of the Trans-Canada Pipe Lines Ltd system, which, when completed, will extend 2250 miles from Alberta to Montreal and carry gas from the Bindlors field. G. A. C.

52. Hydraulic-gradient template is useful tool in designing hot-oil pipeline. H. W. Witter. *Oil Gas J.*, 17.9.56, **54** (72), 239.—Steps in the design of hot-oil pipeline systems are outlined and formulæ are provided to take account of factors such as mean ambient temp, rainfall, and types of soil. G. A. C.

53. Washday for a mountain pipeline. A. S. Olsen. *Oil Gas J.*, 3.9.56, **54** (70), 614.—The control of cleaning pigs in pipelines in mountainous country to prevent line damage is described. Selection of proper tools, equipment and detergent, careful planning, and careful control of the cleaning operation are the important factors. G. A. C.

54. Updating a pipeline division. J. D. Foster. *Oil Gas J.*, 24.10.56, **54** (73), 128.—Service Pipe Line Co modernized its pumping equipment by replacing diesel machines by electric motors, installing cathode protection to reduce line maintenance costs, and housing equipment in outdoor-type structures. G. A. C.

55. New pulsation dampener for piston pumps. M. Ludwig. *Oil Gas J.*, 10.9.56, **54** (71), 120.—Formulæ are developed for the design of a new type of pulsation dampener for use with high-speed reciprocating pumps, a feature being reduction of pulsations without use of troublesome gas-filled chambers. Possible variations in pulsation dampener design are discussed. G. A. C.

56. Speed torque studies fit motors to pumps. B. Bejach. *Pipe Line Ind.*, 1956, **4** (4), 22–5.—Factors governing choice of motor are discussed. Additional cost of a slightly oversized motor is less expensive than cost of an elaborate engineering study. Large sizes of motor used for pipeline pumping always include such studies on economical grounds. R. T.

57. How to calculate pipe stresses. Pt 1. How to handle the tabular method. Pt 2. Systems with different moments of inertia. Pt 3. How to handle elbows and bends. K. Hao Hsiao. *Pipe Line Ind.*, 1956, **4** (4), 43–8.—Mathematical analysis of stresses in a three-dimensional piping system. R. T.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

58. Refinery utility installations. J. A. Shaw. *J. Inst. Petrol.*, July 1956, **42** (391), 187–204.—The supply of steam, water, fuel, compressed air, and electricity is described, particular attention being paid to the latter. Typical systems for the distribution of electric power, whether generated *in situ* or purchased, are given and the relative advantages of each system are discussed. Both U.S. and U.K. installations are considered, the varying requirements of each being explained. Future trends are discussed. 5½ pages of discussion are given. C. B.

59. Minimum weight multi-tubular heat exchangers. V. G. Chibaeff. *Rev. Inst. franç. Pétrole*, 1956, **11**, 961–71.—For many applications the tube length of a heat exchanger of given surface can vary within certain limits without significantly affecting the overall heat transfer coeff, *i.e.* the amount of heat exchanged. The weight of the stainless steel components of a stainless exchanger and also the total weight of a carbon steel exchanger are a function of tube length; such function has a min val for a given length. The theoretical study presented determines the corresponding optimum length for stainless steel and carbon steel exchangers, and analyses the economic conclusions therefrom. (Author's summary.)

60. Speed—gas compressor performance calculations. D. P. Johnson and F. E. Culvern. *Oil Gas J.*, 27.8.56, **54** (69), 113.—Use is described of a modern computer to calculate performance compressor equipment and method of presenting the data in the form of curves ready for use by operators. Formulæ are developed and an example worked out. G. A. C.

61. The how and why of surge protection. A. C. Smith. *Oil Gas J.*, 17.9.56, **54** (72), 233.—The use by Mid-Continent Pipe Line Co of air-type chambers on suction side and bladder-type dampeners on discharge side of reciprocating pumps is described. Surge phenomena, ways of detecting surge, and methods of dealing with it are discussed. G. A. C.

62. Where your maintenance dollars go. C. C. Carmine. *Petrol. Process.*, 1956, **11** (6), 48–53.—In refinery operations, maintenance costs add up to 15–25% of total operating costs, and maintenance personnel, 20–50% of total refinery personnel. The article introduces a system whereby excess maintenance costs may be cut down by planned maintenance control. Maintenance costs are segregated from other costs, such as operating or mechanical service job costs, rearrangement and change in construction costs, capital investment costs, controllable costs, etc. The setting-up of actual *v.* budget maintenance costs is advocated and also the breaking down of maintenance costs into costs covering each operating facility. J. H.

63. How General Motors developed its formula for 100 plus octane. W. M. Wiese. *Petrol. Process.*, 1956, **11** (6), 58–9.—A method for measuring motor gasoline octanes above 100 has now been proposed for general adoption by the automotive and petroleum industries. The method developed by technical groups under the sponsorship of CRC is based on a formula: O.N. = 100 + (*PN* − 100)/3, where *PN* is the Army–Navy Performance Number. This relationship is being used today by General Motors for expressing anti-knock values above 100 on high quality gasolines undergoing routine tests in General Motors' research and development work. J. H.

64. How computers can help you. R. L. Davidson. *Petrol. Process.*, 1956, **11** (6), 61–71.—Typical jobs being done by computers, tower cost estimations, multi-component dist, programme initiating, natural gasoline operation, and design of absorbers, are described in a series of reviews of recent technical meeting papers. 2 outstanding advantages of the use of computers are that technical people can then concentrate on technical work, and industrial efficiency can be improved to ward off threats of high costs and competition from other sources of energy and chemical products. Complete models of refineries, or groups of refineries, can be simulated mathematically, including the many possible variations in process operations, feed and product specifications, time schedules of crude oil receipts, customer demands, etc. J. H.

65. Decisions cost money. F. O. Pierson. *Petrol. Process.*, 1956, **11** (7), 71–7.—The pre-planning of maintenance work avoids the cost and time wastage of awaiting " management " decision. The pre-making of management decision, termed standardization, is classified under 2 headings; craft and job standardization. Craft standardization is the approved way a workman is instructed to complete an operation, taking into account tools and materials available; job standardization covers the sequence of operations from cleaning, maintenance, and testing. Examples are given in the application of " time values " to each operation and the setting-up of preliminary maintenance planning estimates. J. H.

66. Multifuel-firing of cyclone furnaces. G. A. Watts and W. L. Sage. *Mech. Engng, N.Y.*, 1956, **78** (9), 823.—Field and lab experience is reviewed, and some of the recent developments in the use of the cyclone as a multifuel burner are described. The cyclone furnace can be used to burn solid fuels, *e.g.* bituminous coals, lignites, and coal chars individually or in combustion. Liq or gaseous fuels can also be burnt, in a cyclone as combination fuels or as alternative fuels, at reduced air pressures to improve economy. Petroleum coke, petroleum pitch, wood waste, and coke breeze can be burnt in combination with coal, oil, or gas. When a solid fuel combination is used the ash content must be sufficient to provide a liq coating on the walls of the cyclone. In general, waste or by-product fuels can be used with little or no preparation; the main requirement is that they be fed to the cyclone at a uniform rate. D. K.

67. Radio isotopes help solve refinery problems. G. Weber. *Oil Gas J.*, 27.8.56, **54** (69), 99.—Pt I of this series of 4 describes use by Esso Standard Oil Co of radio isotopes in study of alkylation efficiency, mixing efficiency in a grease plant, and in measurement of a fluid bed in a new 10,000-b.d. fluid coking unit at Baltimore. G. A. C.

68. New cooling tower uses no fans. A. Salazar, Jr., F. H. Dotterweich, and C. V. Mooney. *Pipe Line Ind.*, 1956, **4** (4), 20–1.—Description and tests of economical tower which utilizes natural air circulation passing horizontally through the spray in 2 stages. Uses: spray ponds, forced and natural draught cooling towers, where it is necessary to conserve water. R. T.

DISTILLATION

69. Distillation. Calculation principles. P. Boutaud de la Combe. *Rev. Inst. franç. Pétrole*, 1956, **11**, 913–47.—Methods used for dist calculations are discussed and explained, and procedures of Sorel, Lewis, McCabe–Thiele, Ponchot–Savarin are described for the determination of the No. of theoretical plates, optimum feed position, and reflux ratio for binary and multi-component mixtures. (Author's summary.)

70. Distillate storage stability. W. A. Konrad, T. S. Tutwiler, and N. Shipley. *Petrol. Process.*, 1956, **11** (9), 145–9.—Filter plugging is the basis of Esso Research and Engineering Co's new, fast, easy-to-run test for the storage stability of heating oils. Esso's " Accelerated Filter Plugging Test " is designed to assure the refiner that his fuel will not sludge in feed use. Unless careful processes or additives, or both, are used, sludge can form in middle dist fuels incorporating cracked stocks. The test method selected to study the sludge consisted of filtering it out with a simulated line filter; measuring pressure drop across the filter; weighing sludge held on the filter; and visually rating the A.F.P. filter element. J. H.

CRACKING

71. Slide valves—their upkeep and adjustment. J. S. Clarke. *Oil Gas J.*, 24.9.56, **54** (73), 112.—Pointers are given in the upkeep and adjustment in one of the most important elements in cat handling system of fluid cat crackers. Such valves need special attention in design, operation, and maintenance. Service experience is given. G. A. C.

72. Platforming of paraffin wax. P. Schenk, A. B. H. Vervoorn, H. I. Waterman, and A. B. R. Weber. *J. Inst. Petrol.*, July 1956, **42** (391), 205–16.—Investigations were carried out on the influence of temp, contact time, and molar ratio H_2/wax on the reaction products from the platforming of paraffin wax. The conditions favouring hydro-cracking, isomerization, or cyclization are discussed. Pt I deals with the determination of isomerization by specific refraction–specific parachor method, and the determination of the mean total number of rings/mol by the *n–d–M* method. Many figures and 14 refs are given. C. B.

73. Cat reactor design problems. III. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (9), 211–14.—A detailed step-by-step procedure is given for the sizing by incremental calculations of non-isothermal, non-adiabatic reactors for both backmixing and longitudinal operation. The effect of the rates of diffusion of reactants and products to and from the cat surface is discussed. D. H. A.

74. Maintenance of catalytic cracking units. 4. Flexible pipe joints. J. S. Clarke. *Oil Gas J.*, 10.9.56, **54** (71), 108.—Factors are discussed such as absorption of compression, tension, angular movement, and lateral movement due to thermal expansion in the cat cracker piping system in the design and maintenance of such a system. G. A. C.

75. Making ethylene. 5. How to recover ethylene from hydrocarbon mixtures. H. C. Schutt and S. B. Zdonik. *Oil Gas J.*, 30.7.56, **54** (65), 171.—The Linde unit is described, and includes those for compression liquefaction, gas separation, and recovery by refrigeration from the products by heat exchange. G. A. C.

76. More gasoline and less coke. J. D. Heldman, F. Kunreuther, J. A. Marshall, and C. A. Rehbein. *Petrol. Process.*, 1956, **11** (6), 54–7.—Shell Oil Co have recently put into commercial operation a new 2-stage fluid cat cracking process at their Anacortes, Washington, refinery. The new process gives higher gasoline and lower coke yields along with greater flexibility than conventional operations. Virgin feed stock,

a mixture of Alberta feeds, contacts fluidized cat in a riser reactor; total contact time is short, and the use of high temp reduces undesirable coke laydown without destroying gasoline by secondary cracking. All or part of the gas–oil product from the first stage (unconverted or partially converted) is then cracked further in a fluid-bed reactor. Wide operations flexibility is possible by varying the conditions in the 2 zones. The process principles involved can be applied to arrangements such as single-stage riser reactor units to reduce coke where high conversion is not required by the addition of a riser reactor first-stage and other auxiliaries. J. H.

POLYMERIZATION

77. Rexforming and the octane barrier. Anon. *Petrol. Times*, 14.9.56, **60** (1542), 815.—A description is given of the first Rexforming unit to come on stream in the U.S.A. (a second recently came into production at the Big Spring refinery), at the Detroit refinery of the Aurora Gasoline Co, Michigan.

The plant is a modified 7000-b.d. Platforming unit; charge is made from a mid-continent naphtha and consists of *ca* 5500 b.d. of virgin feed material and 1500 b.d. of paraffinic recycle. Tables show properties of reactor feed and octane ratings of non-aromatics. G. A. C.

ISOMERIZATION

78. Penex—Platforming of naphthas. Anon. *Petrol. Process.*, 1956, **11** (7), 66–7.—Universal Oil Products Co recently announced a Penex isomerization process using a fixed-bed, platinum-containing cat in a hydrogen atm. The cat does not require regeneration, and only a single heater and single reactor are needed. Best results are with recycle operation, with product yields around 99·5%. Straight-run naphthas are loaded with low-octane *n*-pentane and *n*-hexane, remaining mostly unchanged during cat reforming. Isomerization increases pentane O.N. from 61·7 to 92·3 (research clear) and 85 to 103·5 (leaded). Hexane research O.N. increases from 24·8 and 65·3 (leaded) to within the range 73·4–102·6 (research clear) and 93·1–107·8 (leaded). J. H.

CHEMICAL AND PHYSICAL REFINING

79. Conditioning gas for transmission. A. L. Kohl and F. C. Riesenfeld. *Pipe Line Ind.*, 1956, **4** (4), 33–7.—Conventional methods for particulate matter removal—solids, iron sulphide or oxide, and liq, lub oil, or liq entrainment from absorber—are discussed. In using amines for chem purification, problems arising are loss of chemicals by vaporization, entrainment, or deterioration, corrosion, and steam consumption. Procedures adopted to effect economical improvements are described. R. T.

80. Acid treatment of shale gasoline. Pt IV. Treatment with an acid resin. G. E. Mapstone and O. P. Van Es. *J. Inst. Petrol.*, June 1956, **42** (390), 171–2.—Sulphonated polystyrene resins were used in the treatment of shale gasoline and were found to enhance the oxidn stability. The resins failed to remove pyrrole polymer, which are normally removed in acid treatment. It is concluded that the resin treatment would therefore be satisfactory only for gasolines containing no pyrroles. 4 lit refs are given. C. B.

SPECIAL PROCESSES

81. Synthetic-rubber plants gain momentum in Britain. Anon. *Oil Gas J.*, 24.9.56, **54** (73), 119.—A review is given of plants being erected in Britain to produce some 80,000 tons of synthetic rubber p.a. Participants include I.C.I., Monsanto, and Dunlop. G. A. C.

82. Survey of petrochemical plants. L. W. Turner. *Oil Gas J.*, 3.9.56, **54** (70), 89.—A company-by-company and plant-by-plant survey of U.S. petrochemical plants, planned, under construction, and operating is given; it is divided into 5 sections, including organic chemicals, nitrogen chemicals, butadiene and copolymer plants, sulphur plants, and carbon black plants. G. A. C.

83. Petrochemicals Ltd expanding again. Anon. *Oil Gas J.*, 24.9.56, **54** (73), 117.—New facilities, which include an installation for production of 25,000 tons p.a. of ethylene oxide, with expansion of steam-power generating facilities, are being started at Partington, and should be in use by mid-1958. G. A. C.

84. Expanding facilities of National Petrochemical Corpn at Tuscola. J. C. Reidel. *Oil Gas J.*, 3.9.56, **54** (70), 105.—This article is in 3 parts, the first giving a brief review of the overall growth of the plant units, the second dealing with process changes made in the ethylene plant to increase capacity from 300 tons to 350 tons/day, whilst the last article describes the U.S. Industrial Chemicals ammonia plant, which utilizes hydrogen from the ethylene plant. Flow sheets illustrate the articles. G. A. C.

METERING AND CONTROL

85. A new chart for use in gas-flow calculators. M. Navidii. *Oil Gas J.*, 10.9.56, **54** (71), 157.—A graph for resolution of problems in gas measurements and pressure drop calculations is given. All variable factors are included in the graphical solution. G. A. C.

86. P.d. meters to streamline terminal work. W. K. Luse. *Oil Gas J.*, 17.9.56, **54** (72), 160.—Details are given of the pipeline's largest meter installation at Interstate Oil Pipe Line Co's Anchorage terminal. 10 p.d. meters handle 275,000 brl crude/day. G. A. C.

87. Metering those heavy Canadian crudes. C. F. Barnard. *Oil Gas J.*, 17.9.56, **54** (72), 154.—Thick waxy Canadian crudes are being successfully metered by the Minnesota Pipe Line, and custody transfer by meters commences in the autumn. Crude oil characteristics and metering methods, calibration, and testing procedures are described, and variations in meter factors discussed. G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

88. Liquid–vapour equilibria between acetone, *iso*propanol, water. B. Choffé and L. Asselineau. *Rev. Inst. franç. Pétrole*, 1956, **11**, 948–60.—Equipment and method are described and results (760 mm) given for the 3 binary systems acetone–water, *iso*propanol–water, acetone–*iso*propanol, and for the ternary system. V. B.

89. Separation of hydrocarbon isomers by thermal diffusion. C. J. Danby, J. D. Lambert, and C. M. Mitchell. *Nature, Lond.*, 1956, **177**, 1225.—Since highly flexible molecules show less persistence of directional velocity than other molecules, and straight-chain paraffin molecules are more flexible than branched-chain ones, it might be expected that isomeric hydrocarbons would be separable by a process such as thermal diffusion. In such a process a *n*-paraffin will leave the hot

zone with lower forward velocity than a branched isomer, and will concentrate in the cold zone.

These theoretical predictions have been confirmed for mixtures of *n*- and *neo*-pentane in a column 100 cm long and a thermal gradient of *ca* 300° C. Equilibrium was reached in 4 hr, and a separation factor R of *ca* 2·3 was obtained, where

$$R = \frac{\%n\text{-pentane at bottom}/\%neo\text{-pentane at bottom}}{\%n\text{-pentane at top}/\%neo\text{-pentane at top}}$$

H. C. E.

ANALYSIS AND TESTING

90. Determination of olefins by means of iodine complexes. Ultra-violet absorption method. D. R. Long and R. W. Neuzie. *Analyt. Chem.*, 1955, **27**, 1110–14.—This paper describes a procedure for distinguishing types of alkyl substituted olefins by means of u.v. spectra of reversible complexes formed with iodine. Intense bands are observed as follows: $RCH=CH_2$, 275 mμ; $R_2=CH_2$, 290–295 mμ; $RCH=CHR$, 295–300 mμ; $R_2C=CH_2$, 337 mμ; $R_2C=CHR$, 317 mμ. The method is of particular interest for the determination of tri- and tetra-substituted derivatives because these types are difficult to determine by Raman or i.r. spectroscopy. Olefin (0·03–0·1 mol/litre) and iodine (0·002 mol/litre) are dissolved in purified *iso*-octane and the u.v. spectrum recorded from 400 to 250 mμ in a cell of 1 cm path length. At these concn it is shown that a simple extension of the Beer's Law equation applies in which the measured absorbence is proportional to the product of the olefin and iodine concn. Apparent molecular "absorptivities" can thus be calculated and are found to be reasonably constant for a given olefin type. J. S.

91. Determination of trace metals in petroleum. Wet ash–spectrographic method. L. W. Gamble and W. H. Jones. *Analyt. Chem.*, 1955, **27**, 1456–9.—It has been previously found that the determination of trace metals in petroleum and its products is of considerable significance. Data have been presented which confirm that trace metals in petroleum dist are more completely recovered by a wet ash or partial sulphuric acid decomposition method than by the conventional dry ash procedure. A wet ash–spectrographic procedure utilizing magnesium nitrate as an ashing and spectrographic aid has been developed. It was found that nickel, vanadium, and manganese can be determined accurately at 0·1–2·0 p.p.m. using 10–50-g samples. The procedure should also be applicable to trace quantities of copper, sodium, and iron when magnesium nitrate free from these elements becomes available. J. S.

92. Determination of furfural in petroleum stocks. O. I. Milner and D. Liederman. *Analyt. Chem.*, 1955, **27**, 1822–3.—Traces of furfural which may remain in lub oil stocks that have been refined by furfural extraction can catalyse oxidn, causing discoloration of the oil during storage. The furfural can be determined photometrically by reaction with aniline in glacial acetic acid–benzene mixture. The colour develops slowly to a max intensity and then slowly fades, but the max colour that develops can be measured and is directly proportional to the furfural content of the oil. The method is reliable for the determination of furfural contents as low as 0·0001%, and is applicable to both dark and colourless oils. J. S.

93. Determination of trace Kjeldahl nitrogen in petroleum stocks. E. D. Noble. *Analyt. Chem.*, 1955, **27**, 1413–16.—The determination of trace amounts of nitrogen in petroleum stocks is of interest because even small amounts of nitrogen poison the cat in reformer units and promote the formation of gum in stored products. The methods previously reported are unsuitable for routine analyses for determining the very low levels of total nitrogen in petroleum stocks. This method covers the modifications of the basic Kjeldahl method permitting the detection of as little as 1 p.p.m. total nitrogen by the digestion of only 5 g of sample. These are: (1) establishment of a colorimetric method (phenol–sodium hypochlorite colorimetric method) for routine determination of low concn of ammonia; (2) purification of Kjeldahl reagents to give a low reproducible blank; and (3) the ability of the Kjeldahl procedure to convert, without loss, traces of nitrogen in organic media to ammonia. J. S.

94. Determining trace metals in petroleum distillates. Efficiency of recovery methods. J. E. Barney and G. P. Haight. *Analyt. Chem.*, 1955, **27**, 1285–6.—6 methods for recovering copper, iron, lead, nickel, and vanadium from a gas oil have been compared with the acid extraction technique; simple ashing, partial sulphated ashing, total sulphated ashing, extraction with iodine, extraction with a mixture of hydriodic and acetic acids, and extraction with a mixture of hydrobromic and acetic acids. Total sulphated ashing, extraction with hydrobromic and acetic acids and acid extraction recovered the 5 metals quantitatively. The other 4 methods were unsatisfactory. Partial sulphated ashing gave no better results than simple ashing. J. S.

95. Determining trace metals in petroleum distillates. An acid-extraction technique. J. E. Barney. *Analyt. Chem.*, 1955, **27**, 1283–4.—Cat refining of petroleum has intensified the study of trace metals occurring in petroleum fractions. Metal analyses that involve combustion of the oil may yield low results because of volatilization or entrainment. A new acid extraction technique has been developed for separating the metals from the oil, after which they are determined by spectrographic analysis. The oil is first extracted with sulphuric acid and then with a mixture of acetone, hydrochloric acid, and water. The extract, after concn, is analysed either spectrographically or by sensitive chemical methods. The extraction procedure is suitable for the analysis of petroleum fractions containing less than 0·5 p.p.m. of metals. About 6 man-hr and 72 hr of elapsed time are required per analysis. J. S.

96. Determination of trace amounts of carbonyl sulphide in gaseous hydrocarbons. R. E. Snyder and R. O. Clark. *Analyt. Chem.*, 1955, **27**, 1167–71.—A simple method for determination of trace amounts of carbonyl sulphide in hydrocarbon gases is based on the reaction with piperidine in alcoholic soln to form piperidine oxythiocarbonate, which is determined spectrophotometrically. The method is applicable to gases containing H_2S, SO_2, and aromatic hydrocarbons not exceeding the equivalent of 50 p.p.m. of benzene; higher concn of aromatics can be tolerated provided they are known or can be determined. The results on synthetic blends are within the range of 2–75 p.p.m. of carbonyl sulphide and are reliable to within 5% of the amount present. A procedure is described for preparing carbonyl sulphide having a purity of 99·9%. The sulphide can be stored at 0° C for several months in a stainless steel bomb without decomposition, provided its initial assay is better than 99·5%. J. S.

97. Spectrographic determination of nickel and vanadium in petroleum products by catalytic cracking. J. E. McEvoy, T. H. Milliken, and A. L. Juliard. *Analyt. Chem.*, 1955, **27**, 1869–72.—Amounts of nickel and vanadium in the range of 0·1–1000 p.p.m. can be rapidly determined in petroleum products by cracking the materials in the liq phase on ground active silica–alumina cat. Nickel and vanadium adsorbed on the cat by this procedure have the same spectro-emission characteristics as artificial standards prepared by the impregnation of the same support with dilute nickel nitrate and ammonium vanadate soln. The spectrographic determination is made by blending the ignited support with a chromium oxide–graphite mixture, pelleting the blend, and sparking

under controlled conditions. The repeatability of duplicated results is generally better than ±5%, and the average deviation between cat and conventional photometric results, determined on 8 different kinds of oils, is within ±15%. For concn in the range of 10 p.p.m., only 2–5 g of sample are necessary; ashing process requires approx 3 hr, and the spectrographic determination of the 2 elements an additional 1¼ hr. J. S.

98. Quantitative spectrographic determination of vanadium in petroleum products by logarithmic sector method. J. A. Kanehann. *Analyt. Chem.*, 1955, **27**, 1873–4.—This paper presents a logarithmic-sector spectrographic method for determining vanadium in petroleum products where the sample is ashed by a controlled procedure and diluted with a buffer of graphite and silica to which 1% titanium has been added as an internal standard. A portion of this mixture is packed into a cratered graphite electrode and arced under prescribed conditions. The titanium and vanadium line lengths are determined with a modified Bausch and Lomb optical magnifier. The vanadium concn is determined by referring to calibration curves, plotting line length difference *v.* concn. J. S.

99. X-ray spectrographic method for the determination of vanadium and nickel in residual fuels and charging stocks. E. N. Davis and B. C. Hoeck. *Analyt. Chem.*, 1955, **27**, 1880–4.—An X-ray spectrographic method is described for the determination of nickel and vanadium in trace quantities.

The method is fast, requires in most cases no more than 20 g of sample, and is comparable with other methods in accuracy. The sample to be analysed is ashed with the aid of sulphuric acid and subsequent soln of the ash. An aliquot of the soln is evaporated on the sample plate and analysed with the X-ray spectrograph for nickel and vanadium. The intensity of the fluorescent radiation from the sample is determined, which is a function of the metal concn.

Procedures are described for the removal of interfering elements, particularly iron. J. S.

100. Determination of trace metals in oils. J. T. Horeczy, B. N. Hill, A. E. Walters, H. G. Schutze, and W. H. Bonner. *Analyt. Chem.*, 1955, **27**, 1899–903.—Metals such as nickel, vanadium, iron, and copper in trace quantities have a deleterious effect on certain processes in the petroleum industry. It has been shown that some of these metals are present as organic complexes which are volatile and that a wet-ash procedure recovers more of the metals present in petroleum fractions than a dry-ash technique. It has never been shown conclusively that a wet-ash procedure recovers quantitatively the metals from volatile porphyrin complexes.

The preparation of tetraphenylporphyrin and its metallic derivatives (iron, nickel, vanadium, and copper) is presented, as well as the results of wet- and dry-ash procedures on synthetic blends of iron, nickel, vanadium, and copper derivatives of porphyrins. J. S.

101. Chromatographic determination of gums in fuels. H. S. Knight, T. Skei, S. Groennings, and A. C. Nixon. *Analyt. Chem.*, 1956, **28**, 8–11.—A novel chromatographic method for the determination of gum in small fuel samples is presented. A small glass adsorption column with a long capillary extension is filled with fine silica gel and 0·5–1·0 ml of sample is introduced, followed by a small amount of 1-methyl-naphthalene as solvent and acetone as eluent. The length of the brown column is related to the gum content of the sample. The chromatographic method for determination of gum gives values that appear to be acceptably close to the steam jet results for soluble and insoluble gum in the jet fuels and certain gas oils. Preliminary data indicate that the method may be applicable to gasoline. Only *ca* 1 ml of sample is required, and one operator with facilities for 10 columns can make 15–30 determinations in 8 hr. J. S.

102. Determination of high boiling paraffin hydrocarbons in polluted water. F. J. Ludzack and C. E. Whitefield. *Analyt. Chem.*, 1956, **28**, 157–60.—This paper describes an improved method for the investigation of polluted water. The use of a liq–liq extraction process with air agitation was found to be effective for the recovery of oil from non-homogeneous samples, chromatographic techniques to isolate mineral oil from animal or vegetable oils, soaps, and other miscellaneous extractable materials found in polluted water, and i.r. analysis provided a quantitative measure and specific class of the hydrocarbons present. This procedure makes it possible to determine the amount, type, and condition of oily residues in the presence of mixed components in polluted waters. J. S.

103. Analysis of hydrocarbon fraction of gilsonite. J. M. Sugihara and T. F. McCullough. *Analyt. Chem.*, 1956, **28**, 370–2.—Chromatography of gilsonite using a magnesol (hydrated magnesium acid silicate) as the absorbent, with celite added to increase permeability of the bed, showed that 4–8% of a hydrocarbon material can be separated from it. This material has been named the giltene fraction of gilsonite. From u.v., i.r., hydrogenation, and urea adduction studies it was found that the giltenes contain 30–40% of aromatic mol and 60–70% of naphthene mol. J. S.

104. Gas chromatography. Use of liquid-modified solid adsorbent to resolve C_5 and C_6 saturates. F. T. Eggerton, H. S. Knight, and S. Groennings. *Analyt. Chem.*, 1956, **28**, 303–6.—A new type of column packing for gas chromatography consists of an active solid to which a small amount of solvent has been added. The amount of solvent is sufficient to prevent or greatly reduce the tailing of chromatographic peaks usually encountered with solid active supports, but not to replace the solid as the principal sorbing medium. In such a column it was found that paraffins were retained relative to naphthenes, which is the reverse in the gas liq partition columns. It was found that a mixture containing all 10 of the components commonly encountered in C_5 and C_6 saturates could be analysed. A 50-ft column of a commercial carbon black (Pelletex) containing 1·5% Squalane was found to be most effective. J. S.

105. Spectrophotometric determination of carbonyl sulphide in petroleum refinery gases. F. J. O'Hara, W. M. Keely, and H. W. Fleming. *Analyt. Chem.*, 1956, **28**, 466–70.—A spectrophotometric method for the determination of carbonyl sulphide in refinery gases is based on the reaction of carbonyl sulphide with piperidine in aq soln to form piperidine oxythiocarbamate, which exhibits strong absorption in the u.v. region of the spectrum. The max absorption occurs at 230 $m\mu$ with a stability period of approx 18 hr. Hydrogen, oxygen, nitrogen, carbon monoxide, methane, ethane, acetylene, ethylene, propane, and propylene do not interfere with the method. Techniques are presented for either removing or correcting interferences which result from the presence of hydrogen sulphide, methyl mercaptan, carbon dioxide, sulphur dioxide, carbon disulphide, thiophene, and conjugated di-olefins. An accuracy of 1 p.p.m. carbonyl sulphide can be obtained for synthetic blends within the range of 1–50 p.p.m. and to within 10% of the amount present in refinery samples. J. S.

106. Photometric determination of nickel in petroleum cracking catalyst. A. T. Blackwell, A. M. Daniel, and J. D. Miller. *Analyt. Chem.*, 1956, **28**, 1209.—This paper describes a method for the determination of nickel in cracking cat. The sample 2–5 g is digested with sulphuric and hydrofluoric acids to remove silica and the soln is made up to known vol

in a volumetric flask. An aliquot of the soln is transferred to a 100-ml beaker to which is added 5 ml of 20% tartaric acid soln and 2 ml of 1 to 4 phosphoric acid (to complex iron and alumina). Dilute to *ca* 50 ml, add 5 ml of saturated bromine water, allow to stand for 1 min, add 1 to 1 ammonium hydroxide dropwise to destroy excess bromine, and then add 2 ml excess. Add 6N caustic soda to bring the pH to 11·5 ± 0·5 and then add 2 ml of 1% dimethylglyoxime soln. Transfer to a 100-ml graduated flask, make up to vol, and after 15 min read the absorbence at 530 $m\mu$. Calculate the nickel concn from a previously prepared calibration curve. The method is simple and rapid, and the results compare favourably with the gravimetric procedure. J. S.

107. Interpretation of 10·3 micron infra-red absorption band in intricating oils. S. A. Francis. *Analyt. Chem.*, 1956, **28**, 1171–2.—I.r. absorption by lub oils in the 10·3 μ region is due to 2 different types of structural groups. *trans*-Olefins produce a band at 10·35 μ which is removed by hydrogenation and is not concentrated by thermal diffusion. Another band is produced at 10·27 μ which is not removed by hydrogenation and is concentrated in the bottom fractions by thermal diffusion. This type of structure is probably due to the presence of polycyclic naphthenes. J. S.

108. Micromethods for determining viscosity of high viscosity materials. J. W. A. Labout and W. P. van Oore. *Analyt. Chem.*, 1956, **28**, 1147–51.—For the determination of visc of highly visc materials a micromethod has been developed based on the principle of simple shear of the material between 2 parallel planes under the action of a constant shearing stress. The method can be used for the determination of the visc of thermoplastic materials such as asphalts in the range of 10^4–10^9 poises with an accuracy of 5% and requires only 12–30 mg of sample. J. S.

109. Fractionation of hydrocarbons by azeotropic distillation with fluorochemicals. B. J. Mair. *Analyt. Chem.*, 1956, **28**, 52–6.—It was found that certain fluorochemicals form with the several classes of hydrocarbons a series of azeotropic mixtures whose b.p. are just in the reverse of that for the usual polar azeotrope-forming substances such as alcohols, glycol ethers, etc.

For binary azeotropic mixtures formed between a fluorochemical and a paraffin and *cyclo*paraffin hydrocarbon both having the same normal b.p., the b.p. is lower for the *cyclo*paraffin azeotrope and higher for the paraffin azeotrope. It is possible to resolve a mixture of branched paraffins and *cyclo*paraffins into 2 portions, one containing only branched paraffins, the other *cyclo*paraffins, by azeotropic dist using fluorochemicals alternatively with polar azeotrope-forming substances. J. S.

110. Use of a monochromator in refractometry. Refractive indices and dispersions of high molecular weight hydrocarbons. R. T. Davies, Jr., and W. R. Schiessler. *Analyt. Chem.*, 1955, **27**, 1824–7.—A monochromator with a tungsten filament lamp may be used as a source of monochromatic light suitable for refractive index and dispersion measurements. The index values obtained by the monochromator method and those obtained using the sodium or mercury vapour lamps agree within *ca* ±0·00003 unit. The refractive index of 14 hydrocarbons of high mol. wt. is reported at 25° C and 30° C at a series of 7 wavelengths. J. S.

111. Detection and determination of contamination of aviation gasoline by heavier fuels. J. A. Krynitsky and W. D. Garrett. *Analyt. Chem.*, 1956, **28**, 967–71.—A simple test for field use has been developed and standardized for the detection and determination of small quantities of heavier fuels in aviation gasoline. The method is based on the fact that the height to which a contaminated gasoline will wet a calibrated paper under controlled conditions (creep height) is governed by the quantity and character of the heavy component present. This "creep height" is easily indicated by the incorporation of an oil-soluble dye into the gasoline sample. The effect of heavier fuels is generally to increase the wetting height. It was shown that a linear relation exists between creep height and the logarithm of the percentage contamination. This would indicate that the response is somewhat semi-logarithmic in nature; it is most sensitive in differentiating between the lower levels, *e.g.* 0, 0·5, and 1·0% contaminations. Corrosion and oxidn inhibitors, TEL, and tricresyl phosphate were shown to have no appreciable effect on the creep height of the gasoline. J. S.

112. Total sulphur in hydrocarbons by monochromatic X-ray absorption. B. H. Eccleston and M. L. Whisman. *Analyt. Chem.*, 1956, **28**, 545–8.—X-ray absorption methods provide a rapid means of determining sulphur in petroleum hydrocarbons. By modifying the existing equipment a method has been developed which makes calibration simple and rapid. Monochromatic radiation is obtained by using the fluorescence attachment to an X-ray spectrograph. Samples can be analysed in 20 min with precision comparable with other X-ray methods, as well as some chemical methods. J. S.

113. Total naphthenes in gasoline by refractivity intercept. J. C. S. Wood, A. Sankin, and C. C. Martin. *Analyt. Chem.*, 1956, **28**, 526–30.—Refractivity intercept has been used for some time to determine naphthenes in gasoline. The method is applicable to paraffins and monocyclic naphthenes, but polycyclic naphthenes give somewhat erroneous results. Improved graphs are presented and evaluated for the C_6 range and the C_8 to C_9 range. The graphs are based on the distribution and amount of individual saturated hydrocarbons in the C_5 to C_9 range of the crudes. They can be used to determine total naphthenes in straight-run gasolines with an accuracy of ±2%. The method should not be used for fractions boiling above 200° C and showing more than 60% naphthenes in the saturates, or for gasoline blends containing more than 10% alkylate or highly-branched paraffins. J. S.

114. Gas chromatography. Analysis of gaseous hydrocarbons by gas–liquid partition chromatography. E. M. Fredericks and F. R. Brooks. *Analyt. Chem.*, 1956, **28**, 297–303.—A study has been made of the applicability of gas–liq partition chromatography to the analysis of complex mixtures of gaseous hydrocarbons. Results indicate that good resolution of most of the hydrocarbons through C_5 can be achieved using a 2-stage column in which the sample is partitioned first by di-*iso*decylphthalate and then by dimethylsulpholane. Helium is used as a carrier gas, and the column effluent is monitored by continuously recording its thermal conductivity. Recorded curves for several hydrocarbon mixtures illustrate the separations that are achieved. The use of a 50-ft column containing dimethylsulpholane separates *iso*butylene from 1-butene and gives excellent resolution of the pentenes. J. S.

115. Quality control in petroleum research laboratory. E. J. Newchurch, J. S. Anderson, and E. H. Spencer. *Analyt. Chem.*, 1956, **28**, 154–7.—Because of the expense and time required for most petroleum research projects, it is imperative that all possible information be extracted from the data obtained. A system of statistical quality control applied to both process and analytical data has been a useful tool in accomplishing this. From this programme has come information about the precision of results, the sources of variances, and the measure of statistical control maintained. This has been valuable in planning and controlling experimental work and in the interpretation of results. J. S.

116. Determination of vapour–liquid ratio of motor gasoline. Sunbury apparatus. R. L. Gilpin and F. W. H. Matthews. *Analyt. Chem.*, 1956, **28**, 99–103.—The Sunbury apparatus for the determination of the vapour–liq ratio of motor gasoline is described, together with methods of its operation. Experimental data indicate that the repeatability of the method is $\pm 0{\cdot}5°$ F for vapour–liq ratios of between 10 and 40 and the reproducibility is $\pm 1{\cdot}0°$ F. The satisfactory agreement of the experimental with the calculated theoretical data on a blend of 30 parts of *n*-pentane to 70 parts by vol of *iso*-octane indicate the suitability of the apparatus for the determination of vapour–liq ratio data. J. S.

117. Fractionation of hydrocarbons by adsorption with added components. B. J. Mair, M. J. Montjar, and F. D. Rossini. *Analyt. Chem.*, 1956, **28**, 56–61.—This paper describes a new process for fractionating hydrocarbons by adsorption in which the fractionation takes place in the presence of 2 added components, one in the adsorbed phase and one in the liq phase.

Ethylene glycol mono-ethyl ether or diethylene glycol mono-ethyl ether constitute the component added in the adsorbed phase and heptacosafluorotributylamine or perchlorocyclic ether the component added in the liq phase. The method is effective for the separation of branched paraffins from *cyclo*paraffins. J. S.

118. Recommended methods for the analysis of trade effluents. Sampling and physical examination of the sample. Anon. *Analyst*, 1956, **81**, 492–8.—Prepared by joint A.B.C.M.–S.A.C. committee. Includes procedure for obtaining representative sample of effluents containing 2 immiscible liq of different sp. gr., *e.g.* mineral oil and water. A tube for taking sectional samples from a rectangular culvert or trough or from a previously collected outfall sample is illustrated and described. A 3-ft long, 1¼-inch ext dia heavy-gauge brass tube, to which a brass bucket is attached by lugs and guide rods, is slid downwards through the sample into the bucket which rests on the bottom of the vessel, the tube being held in its lowest position by a spring catch. A bung is inserted into the top of the tube, which is then withdrawn and emptied. W. A. M.

119. Determination of volatile oil in effluents. J. G. Sherratt. *Analyst*, 1956, **81**, 518–25.—Method for traces of light hydrocarbon oils, *e.g.* petrol, white spirit, kerosine, in waters and effluents, dependent on turbidity produced when water is added to acetone soln of oil. 1 litre water (see abs **118** for sampling technique) has the pH adjusted to 10 with NaOH and is then refluxed whilst air is passed through, emergent oil vapours being adsorbed in a tube packed with activated C, from which the oil is extracted by a known vol of acetone, the soln diluted to a known vol with water containing 0·1% (vol) conc H_2SO_4 and 0·1% (vol) Teepol, and the turbidity compared visually or instrumentally with standards. For accurate results the standards should be made up with the same oil as is present in the sample; if the oil is unknown, arbitrary standards must be used, with some loss of accuracy. Procedures are given for ranges 3–15, 12–40, and 40+ p.p.m. Method was also used to determine the solubilities in water of some light petroleum oils (kerosine 3 p.p.m., gasoline 23 p.p.m.). W. A. M.

120. Non-destructive testing of electric strength of liquids. W. P. Baker. *Proc. Inst. Elect. Engrs*, 1956, **103 A**, 337–40.—Details of 80-kV breakdown test equipment in which current is interrupted within few microsec of breakdown, hence avoiding C formation and enabling *ca* 1000 tests to be made without appreciable electrode damage. Repeat tests on the same sample are possible, and no significant increase in electric strength is noticeable up to *ca* 100 tests. Breakdown-voltage/time curves for oil as delivered (road tanker), degassed, degassed and filtered, show increasing flattening. Analysis of gas evolved during breakdown of filtered oil before and after degassing is given; H_2 content rises from 2·5 to 69%. V. B.

121. Space-charge limited current in insulating oil. T. Sato. *Brit. J. appl. Phys.*, 1956, **7** (8), 297–8.—In order to analyse the pre-breakdown phenomena in insulating oil, a hot tungsten filament emitting an abundance of electrons in a vacuum was used as a cathode. The gap between the electrodes was therefore only partly occupied by liq. Currents measured with various voltages and oil depth are explained on the basis of space-charge limitation in the oil, and mobility of the negative ion in transformer oil formed by the attachment of electrons to oil mol was found to be 1×10^{-4} cm/sec/V/cm. C. N. T.

122. Apparatus for friction studies at high vacuum. V. R. Johnson, G. W. Vaughn, and M. T. Lavik. *Rev. sci. Instrum.*, 1956, **27**, 611–13.—A friction test apparatus has been developed which permits accurate measurements under high vacuum. Sliding motion inside the vacuum chamber is accomplished by magnetic coupling through the chamber wall. The lag angle between the magnets, observed by means of stroboscopic illumination, measures the friction. Calibration of the magnetic coupling is obtained from the period of oscillation of the driven magnet with respect to the driving magnet. H. C. E.

ENGINE FUELS

123. Why additives are needed. N. Seely. *Fuel Effic.*, July 1956, **4** (37), 547, 561.—After a brief introduction to the subject of fuel oil burning, the article, the first of a series, discusses the functions of sludge-dispersing agents. C. B.

124. Fuel oil additives and combustion efficiency. N. Seely. *Fuel Effic.*, Aug 1956, **4** (38), 594–5.—The article reviews the effects of additives in fuel oil on combustion products. It is stressed that an additive is no remedy for inefficient operation. Combustion cat are briefly considered, and the importance of sulphur content of the fuel oil is discussed. It is explained that the oil is not treated with additives before delivery, as such treatment would be expensive and would not be required by all consumers. C. B.

125. Test rig for aviation fuel filters. Anon. *Fluid Handl.*, 1956, 243–4.—Brief illustrated description of full-scale test rig at Sunbury, consisting essentially of a 1000-gal storage tank from which kerosine admixed with artificial contaminant (or water) is pumped via integrating flowmeter through filter (or water separator) and returned to the tank or to another similar tank. Sampling points are fitted before and after the filter, gauges show pressure drop. Aux filter is fitted for pre-cleaning kerosine. W. A. M.

GAS OIL AND FUEL OIL

126. Second survey of burner-fuel oils published by Bureau of Mines. *Fuel Oil & Oil Heat*, 1956, **15** (9), 136.—A table and maps are reproduced from National Bureau of Mines Information Circular 7762. The tables represent data on 427 samples of burner-fuel oil typical of the manufacture during early 1956 submitted by 45 petroleum companies. Analyses are given in 5 general groups, and each group is subdivided geographically. D. K.

127. Additives for residual fuel. What they are and their uses. *Fuel Oil & Oil Heat*, 1956, **15** (9), 128.—Abstract of chemical additives for residual fuel by Harris Thompson read to 2nd Annual OHI Commercial–Industrial Oil Burning and Equipment Workshop. Properties necessary for a good additive are listed. 4 examples are given where additives have been successfully used. D. K.

LUBRICANTS

128. Combating cylinder wear and fouling in large low-speed diesel engines. M. J. van der Zijden and A. A. Kelly. *Trans. Inst. Mar. Engrs*, 1956, **68** (8), 272.—The rate of wear and fouling in low-speed diesel engines depends upon the grade of fuel used, operating conditions, design features of engine, and type of cyl oil used. Improvements in any factor will have a favourable effect. The use of emulsion-type lubricants, containing particularly effective additives, for cyl lubrication is discussed in detail. Considerable reduction in wear relative to that experienced with conventional lub oil was obtained. Marked improvements in piston, cyl, and piston rod cleanliness was also observed when using emulsion lubricants. The article is well illustrated with photographs, diagrams, and tables, and there are 5 refs. An appendix deals with the application of the emulsion lubricant. Discussion, correspondence, and authors' reply are included. D. K.

129. Coolant and lubricant application. Aerosol sprays for metal cutting operations. Anon. *Auto. Engr*, 1956, **46** (10), 388.—2 compressed air-operated coolant systems introduced by C. A. Norgren Ltd, Shipston-on-Stour, Warwickshire, "Spray-Lube" and "Mistcool", are described and discussed. The cutting oil or coolant is atomized, entrained in a flow of air from the shop air line, and delivered by a rigid or flexible conduit to the cutting area. The quantity of coolant, volume of air, character of the spray, and air pressure can be regulated as required. D. K.

BITUMEN, ASPHALT, AND TAR

130. Division of road tars with selective solvents. H. Mallison. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (7), 265–6.—Mallison's procedure—adopted by sub-committee "Extraction" of Istrak—is presented in its approved form. The method consists of separate treatment of different samples of a tar with sp solvents (nitrobenzene, anthracene oil + pyridine, toluene), and treatment of one sample with CH_3OH, also dilution of the filtrate from this treatment, with H_2O. The proportions of insol and sol fractions of the tar are indicative of the tar properties and permit evaluation for practical purposes. R. T.

DERIVED CHEMICAL PRODUCTS

131. Nitroparaffin manufacture on the plant scale. P. W. Sherwood. *Chim. et Industr.*, 1956, **76**, 83–4.—Vap phase nitration of propane yields a mixture of nitromethane (25%), nitroethane (10%), 1-nitropropane (25%), and 2-nitropropane (40%), temp 390°–440° C, propane/HNO_3 6/1, equilibrium of the exothermic reaction is attained at use of 75–78% acid in multiple additions. Product proportions can be varied and yield improved by the use of gaseous cat (O_2, Cl_2). Production 4500 tons/year; materials are used as solvents and as raw materials for further syntheses. V. B.

MISCELLANEOUS PRODUCTS

132. Non-flammable paint strippers. B. Berkeley, D. Schoenholz, and J. Adams. *Soap, N.Y.*, 1956, **12** (5), 175; **31** (6), 175.—The changes in U.S. Government specifications dealing with different types of paint remover have been reviewed. This information is presented under the following general classifications—scrape-off and flush-off removers. A literature search revealed very few articles of value to formulators, but those of interest are discussed. Patents containing pertinent data are summarized. D. K.

133. Development and testing of engine degreasers. B. Berkeley and D. Schoenholz. *Soap, N.Y.*, 1956, **32** (9), 47.—Selection of degreaser and solvent is considered. Formulators test, for product stability, dilution characteristics, and emulsion properties is mentioned. Evaluation of the cleaning action of degreasers, using standard soils and metal specimens, and the methods of preparing these are discussed. Development trends show emphasis on product safety. The authors believe the most promising lines of future research are: development of water soluble concentrates containing solubilized grease-cleaning solvents; ready-to-use emulsions that will invert as water phase evaporates and be capable of being re-emulsified by a high-pressure water spray; increased application of non-toxic halogenated solvents; continued investigation into corrosion inhibition systems for protection of white metals. D. K.

CORROSION

134. New inhibitor safeguards vapour spaces against H_2S corrosion. L. W. Jones and J. P. Barrett. *Oil Gas J.*, 24.10.56, **54** (73), 132.—Use and advantages of diethylamine for controlling hydrogen sulphide in vapour spaces of oil well casings, storage tanks, and similar equipment. The low mol. wt. aliphatic amine gives good inhibition in concn as low as 50 p.p.m., is completely miscible with oil and water, and, although it vaporizes readily, can be handled without elaborate equipment. G. A. C.

135. Is your inhibitor doing its job? R. H. Meyer and R. H. Sheldahl. *Oil Gas J.*, 17.9.56, **54** (72), 224.—The use, by Sinclair Pipe Line Co, is described of in-line test coupons and a more rigid test method than that specified by ASTM in corrosion protection.

Data show that surface conditions of the test specimens have a great deal to do with rate of corrosion. G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT

136. The free-piston engine. G. M. Barrett. *Petrol. Times*, 28.9.56, **60** (543), 861.—The principle, history, development, and operation in present applications of the free-piston engine is discussed, together with future possible uses. G. A. C.

137. Small industrial and automotive gas turbines. Anon. *Mech. World*, Sept 1956, **136** (3446), 418.—Recent developments in these fields in the U.K. and abroad are described and illustrated. D. K.

SAFETY PRECAUTIONS

138. Toxicity of some atmospheric pollutants. R. E. Pattle and H. Cullumbine. *Brit. med. J.*, 1956, **2**, 913–16.—Materials investigated (animal expts) included SO_2; H_2SO_4 mist (toxicity increases with particle size and falling temp); smoke from kerosine lamp (very low toxicity); diesel fumes at 4 operating conditions, not producing black smoke (main toxicity due to NO_2, CO only important at excessive fuel–air ratio). Concluded that main toxicity of smog (affecting only hypersensitive subjects) is probably due to S cpds, which are neutralizable by NH_3.

V. B.

139. Smoke in a London diesel bus garage. B. T. Commins, R. E. Waller, and P. J. Lawther. *Brit. med. J.*, 1956, **2**, 753–4.—Results are given for smoke and 3 : 4-benzpyrene concn on 2 nights (1800–0700, divided into 4 periods) in air inside and outside a garage housing 200 buses, mostly powered by the same type of 6-cyl, 9·6-litre engine. Whilst smoke was considerably increased within the garage when vehicles were operating, no significant change was detectable in the concn of 3 : 4-benzpyrene; it is concluded that the concn of the latter is less in the diesel smoke examined than in ambient coal smoke.

V. B.

MISCELLANEOUS

140. Oil and industry. A. C. Hartley. *Fluid Handl.*, 1956, 247–50.—Summary, with special reference to pipelines, of presidential address to sect. G of Brit. Assoc. meeting, 1956.

W. A. M.

141. Oil and aviation. Anon. *Petrol. Times*, 14.9.56, **60** (1542), 819.—A review is given of the use by the Royal Dutch/Shell Group of Oil Companies of the world's airlines, and of its own operation of aircraft. A table shows aircraft owned by Shell and on charter throughout the world (excluding N. America).

G. A. C.

142. Refinery maintenance—do it yourself or contract it? H. P. Evans. *Oil Gas J.*, 17.9.56, **54** (72), 280.—The question of whether refinery employees should handle maintenance or whether the job should be contracted is discussed. In general, most refineries should carry out own maintenance, but specialized maintenance should be done by contractors. The allocation of shutdown and running maintenance work depends largely on local refinery conditions.

G. A. C.

143. Petrochemicals rise 40 per cent in U.K. Anon. *Oil Gas J.*, 10.9.56, **54** (71), 111.—Developments in Esso, I.C.I., British Hydrocarbon Chemicals, Forth Chemicals, and Shell regarding output of petrochemicals are discussed. Greatest developments are in the fields of ethanol, raw materials for plastics, synthetic rubber, and detergents.

G. A. C.

144. Fuel research in 1955. Anon. *Petrol. Times*, 28.9.56, **60** (1543), 861.—This is a review of the 1955 DSIR Report, and concerns fuel oils and research on syntheses of oils and chemicals from coal. Flow properties of residual oils during storage, separation of emulsions of sea water in fuel oil, survey of methods of treating oily ballast water, smoke abatement, and measurements of concn of pollutants are among the subjects reviewed.

G. A. C.

145. Power production and consumption. F. D. Robinson. *Nature, Lond.*, 1956, **178**, 392–4.—Report of the 5th World Power Conference held in Vienna, June 1956. 275 papers were presented.

H. C. E.

146. Organic raw materials, problems and new production methods. K. Winnacker. *Chim. et Industr.*, 1956, **75**, 1365–74.—Lecture. Discussion based mainly on conditions in W. Germany. Sources of C_2H_2, hitherto main hydrocarbon raw material, do not appear capable of further expansion, and olefins will be increasingly required. Modern methods (Hoechst coke process, cat and thermal cracking) for olefin production are described, and separation and transportation methods are outlined.

V. B.

BOOK REVIEWS

Thermodynamic Functions of Gases. Vols. 1 and 2. F. Din. London: Butterworths Scientific Publications, 1956. Pp. viii + 175; vi + 201. 63*s*. each.

Engineers concerned with the design of equipment for handling gases in the process industries have been aware that for many years there has existed an urgent need for a critical survey of the thermodynamic properties of the common industrial gases. The volumes under review represent the first part of a systematic effort to satisfy this demand by a group of authors working under the auspices of the Thermodynamics Committee of the Mechanical Engineering Research Board of the Department of Scientific and Industrial Research.

The first chapter of Vol. 1 reviews in general terms the experimental data required for the estimation of thermodynamic properties of gases. A particularly valuable feature is the discussion of the merits of the various procedures available for these calculations. Some might consider, however, that an otherwise excellent review of techniques is slightly marred by omission of any reference to the extensive work carried out in this field in the U.S.A. by Sage, Lacey, *et al.*

In subsequent chapters specialist authors review critically the available literature concerning the thermodynamic properties of ammonia, carbon dioxide, carbon monoxide, air, argon, acetylene, ethylene, and propane. From this data the authors have computed, by procedures which are discussed in detail, tables of the best values for properties such as the heat capacity, enthalpy, entropy, and volume as functions of pressure and temperature. The data are also presented in temperature–entropy charts, which are also available, at extra cost, in large sizes more convenient for engineering calculations. The use of different systems of units for different gases is an unfortunate feature which in some circumstances will present the user with minor but irritating inconvenience.

In conclusion, the authors, and others concerned, should be congratulated on these very valuable volumes, the production of which has entailed many hours of tedious and laborious computation. When the proposed extension to other gases is complete the series should prove to be of infinite value to workers in these fields for many years hence.

C. W. N.

Scheduling of Petroleum Refinery Operations. Alan S. Manne. Cambridge, Mass: Harvard University Press; London: Geoffrey Cumberlege, 1956. Pp. xii + 185. 40*s*.

Although the author considers his prospective readers will be either general economists or else specialists in petroleum engineering, he presents a useful mathematical approach to some frequent problems confronting those who do not necessarily lay claim to either title but who nevertheless may be particularly engaged in the programming of petroleum refinery operations from a purely quantitative angle. He is at pains to preserve a delicate distinction between the viewpoints of the petroleum engineer and the pure economist, and in the last chapter suggests the evolution of a Technical Economist.

The practical value of this work is enhanced by the fact that the problems selected for solution are, in the main, based on actual happenings. The profitability or realization motive is present throughout the cases worked, and the pitfalls likely to be encountered in interpreting the solutions obtained by means of the author's mathematical models are liberally signposted. In view of the importance of product valuations some readers may wish that more space had been devoted to this aspect.

The particular cases selected for exposition include the problem of a multi-crude oil allocation to five different refineries in one ownership, naphtha reforming and gasoline blending problems, and the integration of cracking, recycling, and blending operations, all of which reveal in ample detail the author's method of solution by mathematical analysis. It may be that those readers with some prior acquaintance with the subject of linear programming will feel more at home with this work.

Although it is assumed that readers will have a fair knowledge of mathematics, the book is easy to follow. Moreover, it will be realized that for a quick solution of the formulæ the application of electronic computers is an obvious step where the magnitude of operations warrants the expense: it is perhaps to be regretted that there is no mention of this.

The newcomer to the petroleum industry is assisted by a short glossary of technical terms, but it is felt that one or two of the author's more colloquial expressions, for example, "seat of pants" estimates, might well have been avoided.

E. LeQ. H.

The World's Tankers. Laurence Dunn. Southampton: Adlard Coles in association with George G. Harrap and Co. Ltd., 1956. Pp. 176. 35*s*.

This is an interesting record of the development of tankers and, even by merely glancing at the many excellent photographs of old and new ships, the rapid development and growth of the industry can be seen.

The subject has been well handled for the general reader and the book, which is very attractively produced, should find an appreciative public.

E. H. T.

Twentieth Century Petroleum Statistics. DeGolyer and MacNaughton. Dallas, Texas: DeGolyer and MacNaughton, 1956. Pp. 87 + x, 87 charts. $7.50.

The 12th edition of this useful compilation of statistical data relating to the petroleum industry brings the information up-to-date to 1955 from 1918. While the major portion of the statistics relate to the U.S.A., details of production, reserves, and refining capacity are given for every other country. Each table is accompanied by a graph in which general trends are readily observed.

Proceedings Thirty-fifth Annual Convention, Natural Gasoline Association of America. Tulsa, Okla: NGAA, 1956. Pp. 104.

Held at Fort Worth, Texas, in April 1956, this convention covered a wide range of subjects within its field, ranging from process calculation techniques to transport, including midget gasoline plants, economics, and corrosion. In a general session the question of fuels for passenger cars in 1960–65 was the subject of a paper which is included.

ASTM Standards in Engine Antifreezes. ASTM Committee D-15. Philadelphia, Pa: ASTM, 1956. Pp. 56. $1.50.

The nine ASTM test methods and two specifications are collected together in this useful publication. The methods of test relate to sampling, freezing point, boiling point, specific gravity, ash content, alkalinity, water, pH value, and corrosion. The specifications concern a hydrometer–thermometer field test and thermometers.

Significance of ASTM Tests for Petroleum Products. ASTM Committee D-2. Philadelphia, Pa: ASTM, 1956. Pp. 134. $2.50.

Specially prepared for those who are concerned with the properties of petroleum products and the methods of their determination. It provides a general idea of the ASTM test methods and of the relative significance of the results.

ASTM Manual for Rating Motor Fuels by Motor and Research Methods. Philadelphia, Pa: ASTM, 1956. Pp. 192. $6.75.

Full details are given of ASTM D 357–53, Knock Characteristics of Motor Fuels by the Motor Method, and of D 908–55, Knock Characteristics of Motor Fuels by the Research Method. Six appendixes are included and provide information and data on operation and maintenance of the testing equipment.

ADDITIONS TO THE LIBRARY

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

147. Recent trends in oil geology—5. J. C. M. Taylor. *Petroleum, Lond.*, 1956, **19** (10), 354.—At present much interest is focused on geological features other than structure, since the growing demand for oil is outstripping the discovery of new fields and the development of existing fields by conventional methods. Various types of stratigraphic traps are considered and attention paid to methods of locating them, since some have been missed by according too great importance to structural "highs." E. A. G. H.

148. Crest displacement and folding of unparallel strata. K. Krejci-Graf. *Erdöl u. Kohle*, 1956, **9**, 141–6.—An exploration well on an anticline crest often encounters different conditions in lower strata. A series of strata may be laid in asymmetrical folds, then eroded to a horizontal surface and superimposed to a discordant surface. Different possibilities of deformation of this surface arise on further compression of the series of strata. Shearing and bending may occur in an unvariable force plane or folding under oblique pressure. Other structures are obtained in the folding of cuneiform strata in an unvariable force plane, which are often the result of unilateral increasing stratum thickness. With oblique pressure at first a syncline is formed. The subject is treated in detail. 23 refs. R. T.

149. Differential thermal analysis : equipment and the possibilities of identifying clay minerals and natural carbonates. G. Baron, J. Levandowsky, and N. Sacovy. *Rev. Inst. franç. Pétrole*, 1956, **11** (6), 818–30.—After indicating the nature of the reactions which are utilized in differential thermal analysis,

the apparatus in the laboratories of the Institut Français du Pétrole is described. This has 4 furnaces, with a common set of electrical heating and recording equipment, and can make 8 analyses in a day. Detailed diagrams are given. Chromel–alumel couples are used because they are more sensitive than *Pt/Pt–Rh* 10%. They deteriorate rapidly, but are quickly replaced. A heating rate of 25° C/min is used, and so a run to 1000° C takes 40 min. The form of the curves is dependent in some measure on the equipment. The samples and the standard must be finer than 40 μ, and tight packing is best. The atmosphere in the furnace is of importance when the reactions involve changes in weight.

The D.T.A. curves for a series of minerals are described, and the quantitative examination of mixtures of calcite and dolomite, and of chlorite and kaolinite, is discussed.

G. D. H.

150. Methods in sedimentary petrography and their application in determining the sedimentary environment. S. Galovic and N. Glumicic. *Nafta (Yugoslavia)*, 1956, **7** (9), 273–83.—A survey of modern methods in sedimentary petrography is given, and the possibilities which it offers to geologists in the prospecting and development of oil reservoirs are pointed out. The results of the application of some of the methods in the study of recent and old formations in America and Europe are discussed. (Authors' abstract.)

151. Dynamics of near-shore sediment movement. J. W. Johnson. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2211–32.—Considerable research on the basic mechanics of shoreline processes has been done over the last 15 years, much of it during the war, but in more recent years numerous investigations have been made in connexion with the qualitative and quantitative effects of shoreline structures on nearshore sediment movement. This paper summarizes some of the more important investigations that have been made on the many phases of this phenomenon. An extensive list of references is included to permit the reader to study further into the particular problems of interest. E. N. T.

152. Archipelagic aprons. H. W. Menard. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2195–210.—*Ca* 90% of the sea floor of the Pacific basin is a hilly terrane with a relief measured in hundreds of feet, a seemingly endless succession of hills, valleys, ridges, and troughs. The remaining 10% of the sea floor is smooth, of which 2% is distributed near the margins of continents, and 8% is distributed around island groups. The smooth sea floor around each island group has the form of an apron.

In the central and W. Pacific, aprons encircle the Caroline, Cook, Ellis, Gilbert, Line, Marquesas, and Marshall Islands and the guyots of the Mid-Pacific Mountains, Emperor Seamounts, and the Magellan Seamounts. The apron around the S. part of the Hawaiian Islands is exceptionally thin and has been deformed. In the E. Pacific, the Revillagigedo Islands and isolated Clipperton Island lack extensive aprons, and the Galapagos apron is thin.

Seismic refraction measurements show that volcanic rocks are kilometres thick in the vicinity of all islands where studies have been made. This material forms the bulk of the archipelagic aprons and buries the pre-existing hilly terrane of the sea floor so as to form a relatively smooth plain. The perfection of levelling and smoothness of the aprons indicates deposition of sediment by turbidity currents. E. N. T.

153. Regional and local components in facies maps. W. C. Krumbein. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2163–94.—The author points out that distinction between regional and local facies maps is commonly based on map scale, area covered, and tightness of control. An alternative manner of distinguishing between regional and local effects on maps of any scale can be based on the relative areal persistence of regional trends in contrast to the lesser areal persistence of local fluctuations. The regional trends reflect relatively broad tectonoenvironmental controls on sedimentation, whereas the more local fluctuations may be due to smaller-scale environmental, structural, or pre-existing topographic effects.

Principles underlying practical ways of separating regional and local effects on maps of any scale are illustrated by conventional graphic methods adapted from geophysical practice, as well as by analytic methods that permit more detailed study of regional gradients. Examples of analysed facies maps suggest that the separation of these effects may afford a basis for sounder interpretation of facies maps in general, as well as indicating local areas where economically-important departures may occur from the regional facies patterns.

E. N. T.

154. Laboratory measurements of heat conductivity of sedimentary rocks. H. Zierfuss and G. van der Vliet. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2475–88.—An apparatus is described for measuring the heat conductivity of core samples. With the aid of this apparatus the heat conductivities of a number of sandstone and limestone core samples were determined. The cores were entirely or partly saturated with air, water, or kerosine.

It was found that a unique relation exists between porosity and the arithmetical product of thermal conductivity and the formation resistivity factor.

Differences between the heat conductivities of cores partly saturated with water and gas and of cores completely filled with oil or water are so small that the thermal conductivity cannot be considered indicative of the nature of reservoir contents. E. N. T.

155. Analysis of radioactive sources in aeroradiometric surveys over oilfields. A. F. Gregory. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2457–74.—In view of recent claims, the author suggests that a revaluation of aeroradiometric data obtained in oilfield surveys is now necessary. It is stated that the data obtained in 2 specific surveys shows that distinct γ-ray patterns exist but that these patterns have been incorrectly interpreted. A direct correlation of these patterns can be made with the geological, pedological, and hydrological elements of the terrane. It is concluded that there is no direct correlation of surface radioactivity with oil at depth. Thus, it appears that aeroradiometric techniques are of little assistance in the location of oil pools, although they may aid in the location of outcropping petroliferous rocks which are radioactive. E. N. T.

156. Dimensional grain orientation studies of recent coastal sands. J. R. Curray. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2440–56.—The present study deals with the preferred grain orientation obtained in undisturbed samples of artificially lithified sands collected from a variety of modern beaches and Recent abandoned beaches.

The data presented show that there is a strong tendency for elongate grains to align themselves with their long dimensions parallel with the direction of the depositing current of air or water. This direction is parallel with the backwash direction of waves on a beach and therefore averages approx perpendicular to the beach trend, although some deviation may be caused by a longshore current. Characteristic patterns showing the local fluctuations in current direction are found in hooked spits and washover deltas. The preferred orientation direction of wind-deposited sands is approx parallel with the wind direction, and for a composite of a large number of samples appears to approach the prevailing wind direction. The preferred orientation of randomly selected wind- and wave-deposited samples from Recent elongate coastal sand bodies isolated from the ocean by progradation averages approx perpendicular to the trend of the sand bodies.

E. N. T.

157. Objective—a method of search for crude and natural gas reservoirs. J. Borowski. *Nafta (Krakow)*, 1955, **11**, 129–31.—Author points to the recent discoveries of oil and gas in areas never suspected of possessing them. New methods and strict collaboration between teams using complementary methods yielded these results. In view of the need for fresh oilfields in Poland this lesson will have to be learned. Great increase in scientific staff is required. M. S.

158. Distribution of petroleum deposits in time and space on the World's surface. L. Barrabe. *Rev. Petrolière*, July 1956, (981).—At the 17th International Geological Congress, 1937, in Moscow, Stepanow stated how C reserves, accumulated on the globe's surface, are distributed during various geological periods. Large C reserves have accumulated during periods characterized by intense orogenic movements; during periods of orogenic calm deposits are rare. Palæoclimatic or tectonic factors have played an important part in the coincidence of max accumulation of C deposits and intensity of orogenic phenomena. A comparable study of petroleum distribution is presented. Erosion can involve more serious damage in petroleum reserves than in C reserves. Tectonic phenomena can destroy deep accumulations; action on C deposits is limited. Only a pronounced metamorphism can destroy the latter, transforming them to graphite deposits. Probably asphalt and heavy oil deposits have undergone the same evolutions. In absence of statistical world figures those for the U.S.A. are given, relating geological age and oil reserves. Taking into account the abs length of geological periods based on rate of disintegration of radioactive elements, petrol vol in million brl/million years can be evaluated as tabulated. The data and implications are discussed.
R. T.

159. Miocene formations and vertebrate biostratigraphic units, Texas Coastal Plain. J. A. Wilson. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2233–46.—The occurrence of fossil vertebrates in quantity on the Texas Coastal Plain justifies the establishment of biostratigraphic units within the lower-middle and upper Miocene and reveals certain misinterpretations of the stratigraphy. The conclusions reached in this paper are based on an extensive study of the literature, old collections when they could be found, visits to old localities, and study of the more recent, extensive collections at the Bureau of Economic Geology at University of Texas. Traceable biostratigraphic units or faunas are used to correlate and identify Miocene formations along the Texas Coastal Plain: Arikareean, Hemingfordian, Barstovian, and Pliocene biostratigraphic units are here recognized. E. N. T.

160. Marathon folded belt in Big Bend area of Texas. W. E. Hall. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2247–55.—Rocks of the Marathon folded belt are exposed only in the Marathon basin and the Solitario uplift in Texas and (as the Ouachita folded belt) in the Ouachita Mountains of Oklahoma and Arkansas. The author suggests in this paper that the Marathon folded belt in the Big Bend area of Texas was deformed by 2 distinct late Palæozoic orogenies. The first occurred during the Lower Pennsylvanian and the second during the early Permian. These distinct movements have long been recognized in the literature, but are usually discussed as a single orogenic system (the Ouachita, or the Marathon) with several pulsations. The analysis of numerous limestone samples led the author to the following conclusions:

(1) There is no simple relation between the Ca–Mg ratio and the age of carbonate rocks. There is, however, a general decline in abundance of dolomites (or increase in the average Ca–Mg ratio) in going up the geologic column, with superimposed periodic fluctuations of calcitic and dolomitic limestones.

(2) Dolomite can precipitate directly out of sea water upon evaporation at high CO_2 pressure.

(3) The chemical analyses of 3500 samples of limestones and dolomites show the predominance of dolomites with Ca–Mg 2 and limestones having Ca–Mg 32. The dominance of pure limestones and dolomites has been previously brought out by Steidtmann.

(4) There seems to be no relationship between the Sr–Ca and Ca–Mg ratios.

The future line of research suggested by this work is the establishment of the upper and lower limits of CO_2 pressure at which dolomite can precipitate directly out of sea water. This might shed some light upon CO_2 pressure of atmosphere during the pre-Cambrian and Palæozoic time. E. N. T.

161. Fauna and bathymetry of banks on continental shelf, Northwest Gulf of Mexico. R. H. Parker and J. R. Curray. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2428–39.—A feature peculiar to the outer continental shelf of the NW. Gulf of Mexico is the series of pinnacle-like banks or topographic highs rising abruptly from the generally smooth, sediment-covered bottom. The data presented in this paper represent recently-obtained information on the bathymetry and fauna of these features which may be related to their origin.

Despite the existence of dead reef coral, no living forms were collected. Living lithothamnioids were common on all banks. Evidence suggests that the tops of these banks were in shallow intertidal waters at a time when overall water temp were warmer than at present, and when populations of these faunas became isolated and the corals which appear to form the primary organic capping ceased their growth, leaving horizontal surfaces. The presence of large crystals of gypsum and inclusions of anhydrite from the flanks of one bank may have a bearing on the original topographic high at this place.
E. N. T.

162. Environmental relationships of grain size and constituent particles in some South Florida carbonate sediments. R. N. Ginsburg. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2384–427.—The increasing interest in defining the environment of deposition of ancient sedimentary rocks has focused attention on the basis of interpretation, the marine sediments forming and accumulating on the present sea floors. This paper describes the results of a study of recent carbonate sediments in S. Florida which suggest how some depositional environments are reflected by the grain size and constituent particles of their respective sediments.

2 major environments can be recognized: (1) a curving band-shaped reef tract with good water circulation, and (2) Florida Bay, a very shallow triangular area with semi-restricted water circulation.

Florida Bay sediments have larger proportions of particles less than $\frac{1}{8}$ mm than the sediments of the reef tract. The constituent particle composition of the fraction larger than $\frac{1}{8}$ mm in Florida Bay is almost exclusively molluscan and foraminiferal, but in the same size fraction of the reef-tract sediments, fragments of algæ and corals are abundant. Similar distinctions in grain size and constituent particles for comparable environments can be derived from published data for the sediments around Andros Island, Bahamas. E. N. T.

163. Revised nomenclature of Mesaverde group in San Juan basin, New Mexico. E. C. Beaumont, C. H. Dane, and J. D. Sears. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2149–62.—Recent geologic mapping in the W. part of the San Juan basin in New Mexico has essentially completed the mapping of the Cretaceous rocks of the W. side of the basin on a scale of one inch to the mile or larger. The differing systems of nomenclature for these rocks on the N. side of the basin in Colorado and the S. and E. sides of the basin in New Mexico have thus

been brought into contiguity, and the resolution of some of the differences was required. This note sets forth the nomenclature now planned for use in reports and maps of the U.S. Geological Survey and briefly records the previous situation in respect of geologic names for the units. E. N. T.

164. A look at Paradox oil in the Four Corners region. S. A. Wengerd. *Oil Gas J.*, 24.9.56, **54** (73), 106.—The oil geology of the Paradox basin in the Four Corners region of Utah, Colorado, Arizona, and New Mexico is described. The major accumulations are in the Upper Paradox in biohermal, partly dolomitized calcarenites. Smaller accumulations occur in other carbonate rocks having solution porosity grading into intergranular porosity. C. A. F.

165. Eight Paradox strikes . . . is a perfect '56 score in prospect? N. S. Morrisey. *Oil Gas J.*, 1.10.56, **54** (74), 149.—8 discoveries have so far been made in 1956 in the Paradox basin in the Four Corners area of Colorado, New Mexico, Arizona, and Utah. The largest field found is at Aneth in Utah, which now has established production for a length of 5 miles. Pay is, however, only 4 ft thick. C. A. F.

166. Ralston formation of Cañon City embayment, Colorado. E. A. Frederickson, J. M. de Lay, and W. W. Saylor. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2120–48.—The Cañon City embayment is a structural re-entrant in the E. front of the Rocky Mountains near Cañon City, Colorado. The embayment is formed by the *en echelon* arrangement of the Front Range and the Wet Mountains, and is located between the S. end of the Front Range and the E. flank of the Wet Mountains. Paralleling the margin of this structural embayment is a conspicuous belt of sedimentary rocks ranging in age from Ordovician to Pliocene. The Jurassic Ralston formation outcrops in the escarpment face of dipping Palæozoic and Mesozoic strata which flank the S. end of the Front Range. The exposure was traced and mapped from Cañon City to Colorado Springs, Colorado. 31 detailed sections were measured. 10 representative sections are included in this paper. E. N. T.

167. Lower Cretaceous stratigraphic units of Northern California. M. A. Murphy. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2098–119.—A thick succession of fossiliferous Lower Cretaceous clastic rocks outcrops near Ono, California. Although these rocks have been studied for almost 100 years, no detailed maps or sections have ever been published.

This district is the type area for the stratal unit previously called the Horsetown "group" or "formation," which is here redefined as the Horsetown stage. 8 biostratigraphic zones, ranging in age from Hauterivian to late Albian in the European time scale, are defined within this stage. The upper and lower boundaries of the stage are defined by the bases of the zones of *Pervinquieria hulenana* and of *Neocraspedites aguila*, respectively. E. N. T.

168. Middle and Upper (?) Ordovician rocks of Independence Quadrangle, California. R. L. Langenheim, Jr., J. A. Barnes, K. C. Delise, W. A. Ross, and J. M. Stanton. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2081–97.—This paper describes the Middle and Upper Ordovician rocks of the Mazourka Canyon area, which have long been poorly known and greatly misunderstood. Because these rocks are part of the westernmost relatively unmetamorphosed Palæozoic section in the S. Cordilleran geosyncline, it is desirable that they should be adequately described. The importance of this section has become more apparent as extensive study in the Great Basin has shown that the general area between Lone Pine, California, and Austin, Nevada, is the site of rapid facies changes between the Palæozoic miogeosynclines and eugeosynclines.

It is pointed out that the 4 Middle and Upper (?) Ordovician formations are exposed E. of Mazourka Canyon in the Independence Quadrangle. The Chazyan Mazourka formation, approx 500 ft of limestone and shale, conformably succeeds Early Ordovician (?) dolomite and belongs to the Pogonip group. The overlying Barrel Spring formation, approx 150 ft of Mohawkian sandstone, shale, and limestone, is assigned to the Eureka group. Approx 200 ft of Mohawkian argillaceous limestone, dolomite, and quartzite make up the unnamed remainder of the Eureka group. Approx 175 ft of Upper Ordovician (?) dolomite resting on the Eureka group is tentatively assigned to the Ely Springs formation. Silurian rocks disconformably succeed the Ely Springs formation. E. N. T.

169. Oakridge fault gives up Pliocene production. W. T. Smith. *Oil Gas J.*, 15.10.56, **54** (76), 186.—During the past 4 years fields have been developed along a string of anticlines associated with the Oakridge thrust fault in Ventura County, California. The fault trend includes 6 anticlines, 5 of which are productive, and accumulations are being found in fault traps beneath the thrust. Pays are Pliocene below overthrust Oligocene, Miocene, and Eocene. Brief details of each field are given. C. A. F.

170. Alberta spotlight shifts to South. F. J. Gardner. *Oil Gas J.*, 17.8.56, **54** (72), 367.—There have been a number of new discoveries in S. Alberta in recent months, and 4 of these are briefly described. They are A 13-2 Crossfield, 18 miles N. of Calgary, which found light gravity oil in the Cardium at *ca* 6700 ft; 1 Dahl, 65 miles SE. of Calgary, which on test recovered 5060 ft of 43° oil from an unidentified Cretaceous sand; 1 Medicine Hat, *ca* 15 miles NW. of Medicine Hat Field, which found Cardium gas at *ca* 2000 ft; and a well at Youngstown which found Devonian–Jefferson oil at approx 3700 ft. C. A. F.

171. Methy dolomite of Northeastern Alberta: Middle Devonian reef formation. H. R. Greiner. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (9), 2057–80.—In the waterways area of NE. Alberta, the Middle Devonian Methy dolomite overlies claystones, shales, and redbeds which rest unconformably on Precambrian granites and gneisses. A type core section and detailed lithologic description of this dolomitized reef are given in this paper, and criteria found useful in identifying subsurface reef developments are enumerated. Fossils of Middle Devonian age enable the Methy dolomite to be correlated with the Winnipegosan, Presqu'ile, and Ramparts formations of W. Canada. In thickness the Methy dolomite varies from *ca* 113 ft at Bear Rodeo No. 1 to 227 ft at Bear Westmount No. 1. The author emphasizes the great variation in thickness, commonly associated with formations of a reef nature, which the Methy dolomite exhibits. E. N. T.

172. Cardium concept due for overhauling. F. J. Gardner. *Oil Gas J.*, 15.10.56, **54** (76), 185.—Recent discoveries in Alberta have indicated that the Cardium sand, first found productive in the Pembina field, has reservoir possibilities much farther S. and E. than previously supposed. A well 18 miles N. of Calgary and one 250 miles SE. of Pembina have discovered Cardium production this year. In the Keystone area due E. of Pembina, 2 discovery wells have had natural flow from the Cardium, whereas at Pembina most completions require fracture treatment. C. A. F.

173. Pemex uncovers another new oilfield in continuation of the New Golden Belt. Anon. *World Oil*, 1956, **142** (7), 278.—A new field has been reported at Guillermo Prieto, between Reynosa and Brazil in Tamaulipas, Mexico. It is believed to be a continuation of the New Golden Belt. Other recent discoveries include Las Carras, *ca* 20 miles N. of Poza Rica in the New Golden Belt, and Boca de Lima, *ca* 8 miles from Gutierrez Zamora. Drilling has shown good results in the San Andres area, 25 miles SE. of Poza Rica. C. A. F.

174. Cost of oil exploration in Colombia. E. Ospina-Racines. *Oil Forum*, 1956, **10**, 273.—Intercol has faith in future development of Colombia socially and politically. The exploratory outlay to date is $102,000,000, which calls for discovery of 500,000,000 brl of oil. R. T.

175. Geology of petroleum deposits in Sub-Andes zone of South American Cordilleras. H. Gerth. *Erdöl u. Kohle*, 1956, **9**, 147–50.—The Sub-Andean zone constitutes a region of varying width on the inner edge of the Cordilleras in which uplifts die away gradually. It can be traced from Trinidad in the NE., through the whole continent to Tierra del Fuego. In marine Tertiary strata oil is found in the N. in Venezuela and Trinidad, coming partly from the chalk. In the extreme S. the Tertiary is again marine developed; no oil is found. Its first occurrence is in sands below the chalk; it may arise from upper shale. In Neuquen oil occurs in sandstone of Malm and Upper Dogger, into which it has diffused from dark shales of the Lower Dogger. In Mendoza, as the only source rocks of oil, are the natural shales of the Upper Trias. In Peru oil appears in sandstones of the Lower Cretaceous, its origin is unknown. In N. Argentina and S. Bolivia oil is obtained from sandstones of Permocarbon and Devonian, the latter the source rock. Most of the oil deposits in the Sub-Andean zone are connected with structures which have arisen through movements of the Cordillera folding dying away in the foreland. Faults also participate. R. T.

176. Tectonics of the oil region Recôncavo, Bahia, Brazil. H. Putzer. *Erdöl u. Kohle*, 1956, **9**, 223–5.—Recôncavo lies on the N. coast of All-Saints Bay in NW. of Salvador. Up to now 430 deep wells, *ca* 350,000 m, have been sunk. For 10 years the Candeias field has been chief producer. The >5000-m-thick connected strata of Bahia series belongs chiefly to the Lower Cretaceous. The Brotas formation probably belongs to the Jurassic. The most important oil bearer is the Sergi-sandstone. Details of productive fields are tabulated. Geological features and facies changes are discussed and illustrated. 9 refs. R. T.

177. Sediments and water of Persian Gulf. K. O. Emery. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2354–83.—Most of the oil in the Persian Gulf area comes from sediments deposited in a geosyncline to which sediments are still being added. Study of the present conditions of sedimentation may clearly be useful in interpreting the older sediments of the geosyncline. The author presents the results of a 2-week cruise in the Persian Gulf area during Aug 1948, when several ships collected a large amount of information about the sediments and water characteristics. It was found that the water is of high temp, but also of such high salinity that Persian Gulf water sinks and flows out of the Gulf beneath incoming surface water of the Indian Ocean. The high temp and salinity aid the removal of calcium carbonate by molluscs, leading to a dominance of shell fragments in the sediments. The high percentage of calcium carbonate, quartz, and resistant heavy minerals is characteristic of an area of slow deposition and does not fit the common concept of geosynclinal sediment, non-calcareous graywacke. Mesozoic and Tertiary strata of the geosyncline also contain much limestone. Evaporites, common in the older rocks, would be more widely deposited at present if the entrance strait were to become shallower than now by diastrophic uplift. A higher organic content, probably characteristic of the Mesozoic and Tertiary oil source beds, would exist in present sediments if the strait were more open and if the climate were cooler and wetter than now.

Perhaps the main conclusion to be drawn from a comparison of Persian Gulf sediments and of published concepts of geosynclinal sediments is that the present sediments are controlled by their environment of deposition as well as by their areas of derivation. Thus, the abundance of calcium carbonate is a result of the hot, dry climate, and the dominance of silt and clay in the non-calcareous fraction is more a function of weak transporting agents than of incomplete weathering in source areas. Accordingly, climate is an environmental factor that may rival or exceed in importance the geometry of geosynclines and their environs in controlling the nature of geosynclinal sediments. E. N. T.

178. Tests evaluate Kuwait strike. Anon. *Oil Gas J.*, 17.8.56, **54** (72), 137.—Following the completion of a second wildcat, 2 Raudhatain, in N. Kuwait, another well, 1 Sabriya, is being drilled approx 8 miles ESE. A further well is being drilled *ca* 6 miles NW. of 1 Bahrah, the first well drilled in Kuwait in 1936. C. A. F.

179. Spotlight on Pakistani tests. Anon. *Oil Gas J.*, 1.10.56, **54** (74), 73.—A well is being drilled on the outskirts of Karachi to a projected depth of 10,000 ft. 2 Sylhet in jungle country in E. Pakistan is below 8000 ft; the first test in the area found gas at 7800 ft, but the rig and equipment were destroyed by fire. C. A. F.

180. Deep wildcat hits in Sahara. Anon. *Oil Gas J.*, 24.9.56, **54** (73), 105.—A wildcat *ca* 63 miles SW. of Onargla in S. Algeria is reported to have found substantial quantities of good quality oil. This is the third discovery in the Algerian Sahara this year. C. A. F.

181. Wildcat comes to Zanzibar. Anon. *Oil Gas J.*, 15.10.56, **54** (76), 106.—A deep test is being drilled in Zanzibar following intensive geological and geophysical surveying. The well is below 7000 ft, and it is planned to drill to 12,000 ft. Exploration in the area began in 1951, and a previous well was abandoned as dry at 11,051 ft. C. A. F.

182. Review of exploratory oil wells penetrating Permian sections in Central Queensland, Australia. E. A. Webb. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (10), 2329–53.—Since 1935, when Oil Search Ltd commenced its Hutton Creek well, 6 deep tests have been drilled in the Central Queensland area of Australia to test folds in Permian strata. This paper is an attempt to divide the strata penetrated in the wells into formations defined by surface mapping and to correlate between the 6 wells. Electrical logging was carried out on all except the first 2 of these wells, and a geological history of the area is presented, together with a brief review of oil and gas possibilities. E. N. T.

183. Matzen–Auersthal is called Western Europe's No. 1 field. A. M. Stahmer. *World Oil*, 1956, **142** (7), 270.—The first Austrian fields were found near Zistersdorf in the Vienna basin during the 1930s, and are now nearing depletion. Since the war the Matzen and Auersthal fields between Zistersdorf and Vienna have been discovered and developed, and are now considered the largest field group in W. Europe. The structures are local anticlines on an E.–W. uplift. Pays are Tortonian beds at *ca* 5500 ft. Total output is *ca* 52,260 b.d. Control appears to be water drive. C. A. F.

184. Oil in Polish lowlands? J. Wojnar. *Nafta (Krakow)*, 1955, **11**, 102–5.—On the strength of W. German and Dutch exploitation of the North Sea basin, and pressed by the need for fresh resources of crude, Poland's oil industry is going to carry out extensive search in the Szczecin–Lodz syncline and Maritime–Kujawy anticline. Microbiological, geochemical, and geophysical methods will be used, and it is thought that odds are high, since all geologists point to the existence of salt deposits, and traces of crude were found in 15 drillings early in the last war. M. S.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

185. Seismic–magnetic data processing. R. C. Dunlap. *Oil Gas J.*, 15.10.56, **54** (76), 127.—The development of seismic–magnetic data processing is described. In this method information from the shot is stored on a magnetic tape or disk, and it is possible to record the shot with a minimum of predetermined recording techniques. After recording, one variable at a time can be introduced so that the effect of a single change can be evaluated. The form of presentation of the data facilitates the structural interpretation by the geologist and promotes better co-ordination between the geologist and geophysicist. C. A. F.

186. Continuous velocity logging. R. van Nostrand. *Rev. Inst. franç. Pétrole*, 1956, **11** (6), 743–56.—The continuous logging device consists of an emitter acoustically isolated from the receiver, and since the instrument probably lies in contact with the well wall, the mud may have little effect on the miniature refraction shooting. The device and its mode of operation are described.

It was originally intended to provide better data than conventional well velocity shooting for interpreting seismic data, but it has been found that the detailed velocity log can be used for correlation. The log often resembles a resistivity log. Velocity logs have also been considered for investigating the origin of reflections, and synthetic seismograms have been prepared for these investigations.

Seismic velocities have been shown to depend on the porosity, and on the fluid occupying the pores, as well as on the pressure on the fluid and on the external pressure. There are indications that the velocities should increase, other things being equal, according to whether gas, oil, or water progressively occupied the pores. Low porosity was associated with high velocities.

A number of actual velocity logs are discussed and compared with other types of logs. G. D. H.

187. Determination of the coefficients of a linear velocity relationship as a function of depth in seismic reflection work. B. Faure. *Rev. Inst. franç. Pétrole*, 1956, **11** (7), 863–8.—The aim is to obtain a relationship of the form $V = V_o + kz$, where V is the velocity at depth z, and V_o the datum velocity. Miller's method employed the time–depth relationship obtained in well velocity shooting [$t = f(z)$], and called for the selection of 2 points (t_1, z_1 and t_2, z_2), such that $t_1 = 2t_2$ $\left(\text{or } \frac{3}{2}t_2\right)$. This method in practice is less speedy than appears at first sight, and the values of k and V_o depend on the 2 points used, because repetition and plotting are needed to get the best mean values. A modification requires the drawing of a series of curves for $z = \frac{V_o}{k}(e^{kt} - 1)$, using various values for k and V_o. The new method makes use of $\frac{z}{V_o/k} = e^{kt} - 1$, $k\ z/V_o$ being plotted against kt on log–log paper. The observed curve, $t = f(z)$, is plotted on tracing paper, and matching, with the axes of the 2 curves parallel and the position of the point (1, 1) permits k and V_o to be obtained. Several matches can be taken to get mean values.

A comparable graphical technique is also possible when a relationship $V_m = \phi(T)$ is available, V_m being mean velocity and T reflection time. G. D. H.

DRILLING

188. Revolutionary new drilling muds. Anon. *Oil Forum*, 1956, **10** (10), 349.—Lime, caustic soda, and org thinners are replaced by a non-ionic detergent-like org cpd which permits mud flow at temp >400° F. " Rayflo " contains dispersant to replace quebracho. It is a polymeric polyphenol produced from residuals after lumber and cellulose production. R. T.

189. Liquid cyclone cuts cost of treating drilling fluids. W. E. Bergman *et al. Oil Gas J.*, 15.10.56, **54** (76), 114.—The use of a 3-inch dia liq cyclone for separation of solids from drilling mud is described. The equipment is shown in a diagram; it contains no moving parts and is effective with weighted or unweighted muds. The saving in water dilution, compared with pit jetting, is 80–90%. Indirect advantages include improvement in mud control, less wear on pump and bit, and higher penetration rate.

The test cyclone has been used in several Gulf Coast wells. 15 refs. C. A. F.

190. Examination of clays as the raw material for drilling mud. J. Gumulczynski and S. Gierlaszynska. *Nafta* (*Krakow*), 1955, **11**, 82–6.—In the laboratory of the Polish IP work has been done on the clays available in Poland, and results on 5 basic ingredients, with various additions, are given in tabular form. M. S.

191. Oil-based muds. J. Gumulczynski. *Bull. Polish Inst. Petrol.*, 1955, **5**, 5 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—This water-in-oil emulsion is stabilized with calcium naphthenate and asphalt. Composition and method of making it are given. Sensitivity to crude oil, subterranean water, and clays is not critical. M. S.

192. Cyclones save barite, reject clay solids. Pt 1. P. P. Scott and J. L. Lummus. *Oil Gas J.*, 8.10.56, **54** (75), 188.—Lab and field tests have shown that the treatment of weighted drilling fluids with 3-inch cyclones will remove up to 95% of the clay and 95% of barite. The removal of clays from high clay-content lime-base mud by this treatment reduces gelation at high temp. The results of the tests are given. C. A. F.

193. New nuclear radiation logging method. G. Swift and R. G. Norelius. *Oil Gas J.*, 15.10.56, **54** (76), 109.—Multi-spaced neutron logs have been used successfully in Venezuela for distinguishing between gas and oil zones. The technique has shown that generally there is a fixed relationship between the ratio of the deflections of the 2 neutron curves; a large deviation from this ratio indicates gas or a dense zone.

The complete M–S log includes a γ-ray log and 2 neutron logs with different spacings. The 2 neutron curves are " normalized " to coincide in zones of low and medium intensities, but they become separated in gas zones. Specimen curves are included. C. A. F.

194. Oklahoma deep test goes to 14,376 ft. E. A. Skarda. *Oil Gas J.*, 15.10.56, **54** (76), 126.—2 Hale, a deep test in S. Oklahoma on the N. flank of the Arbuckle Mountains between Pauls Valley and Ardmore, has been drilled to 14,376 ft in 372 days. 11 drill-stem tests were made and 330 ft of core were taken. Native mud was used to 2800 ft with caustic-quebracho, 10–12% diesel oil–emulsion mud below; total mud cost was less than $28,000. 311 rock bits were used, and average bit weight in the lower part was 10,000 lb. A chart showing the drilling history is given. C. A. F.

PRODUCTION

195. Study of the flow of gas through porous media; application to determining the rock structure. R. Iffly. *Rev. Inst. franç. Pétrole*, 1956, **11** (6), 757–96.—The flow of liq through porous media presents no special difficulties from the point of view of study, and the rate of flow is usually proportional to the loss of head. In the case of gases, however, the loss of head increases much more rapidly than the rate of flow. This feature has commonly been attributed to turbulent flow,

and to polytropic flow. Except for flow in fissures, it seems unlikely that the Reynolds No. for the flow will attain the critical values indicative of turbulence. The presence of throats between the larger parts of the pores leads to sudden changes in kinetic energy, and this is an important aspect of the flow behaviour.

It is suggested that the law governing the flow of gas in a porous medium should be of the form $\Delta p^2 = aQ + bQ^2$, Q being the rate of flow, Δp^2 being $(P^2 - p^2)$, where P and p are the upstream and downstream pressures; a and b are constants. The Klinkenberg effect appears to be in conformity with the general ideas under consideration.

Relationships between permeability and grain size are derived for loose material with cubic or rhombohedral packing. G. D. H.

196. Two-phase flow through porous media. N. Schwarz. *Ingenieur, 's Grav.*, 4.5.56, **68** (18), M1–6.—The flow of one phase through a porous medium could already be mathematically formulated 100 years ago, but for 2 phases (*e.g.* oil and water) this is in a strict sense not yet possible even today. The simplifications that have been introduced in the various attempts to arrive at a mathematical description, and the results so obtained, are discussed.

Another approach to the problem is by means of model studies. By dimensional or inspectional analysis the variables that govern 2-phase flow can be combined to dimensionless groups, with the aid of which the process can be defined. Lab tests can then be designed with the purpose of determining the functional relationship between the groups. The results are in principle generally applicable also to many natural oil-bearing rocks, the dimensions of which are some orders of magnitude larger than the lab models.

The results of such model studies are of great importance to the technique of recovering petroleum, since crude oil occurs in underground porous formations from which it is displaced by water and/or gas. 8 figs, 8 refs. (Author's abstract.)

197. Planning and supervising workover jobs. J. N. Pedersen. *Petrol. Engr*, 1956, **28** (10), B73–80.—The initial planning is discussed under 4 headings: (1) the present status of the well; (2) analysis of the economic justification of proposed job; (3) outlining the step-by-step plan of the workover; (4) preparation of a detailed cost estimate. Stress is put on this planning, especially with regard to problem wells. Finally, preparation, supervision, and cost control of the workover are outlined. E. A. G. H.

198. Workover problems and their solutions. C. J. Rodgers. *Petrol. Engr*, 1956, **28** (10), B107–27.—Causes and solutions of common workover problems are discussed; in many cases a problem well may have a combination of these "ailments." The problems dealt with are: (1) casing leaks (and collapse); (2) excessive sand production; (3) bad cement jobs; (4) high gas–oil ratios; (5) high water–oil ratios; (6) plugging of the producing formation; (7) re-perforating and re-completing; (8) producing wells to injection wells. E. A. G. H.

199. Evaluation of workover before and after. J. J. Arps. *Petrol. Engr*, 1956, **28** (10), B97–104.—Emphasis is placed here on unusually low productive capacity of a well when there is nothing obviously wrong with its mechanical condition. A short analysis of a typical production graph is made and decreased productivity then evaluated in terms of loss in bottom hole pressure or loss in productive index. Periodical analysis of results after the workover is desirable, typical campaign data being illustrated. E. A. G. H.

200. Permanent type completions and wireline workovers. G. H. Tausch and P. McDonald. *Petrol. Engr*, 1956, **28** (10), B39–52.—A brief history of wireline workovers is given, showing advances made up to the present time. The ideal time to equip wells for permanent completion work is during the initial completion. Details of wireline tool requirements are discussed, together with workover procedures. Finally, workover results are studied. E. A. G. H.

201. Flexibility in gas-lifting multiple completions. W. B. Adair. *Oil Gas J.*, 1.10.56, **54** (74), 78.—The use of fluid-operated valves with a common reservoir of supply gas is described for multiple completions of gas-lift wells. Each string in the well has a set of fluid-operated valves, and the system can lift the required vol for most multi-zone wells and is simple and flexible in operation. Valve interference is eliminated, depth of lift and amount of production can vary widely between different zones, and there is no need for complex surface gas-control equipment. Diagrams showing how the valves are mounted in relation to the flowstring are included. C. A. F.

202. Multiple stage cementing. V. Peros. *Nafta (Yugoslavia)*, 1956, **7** (9), 267–73.—This paper deals with those features of DV multiple stage cementer which make multiple stage cementing a successful procedure when applied to present-day deep high-pressure wells. It describes the operations of DV 2-stage and 3-stage cementers, together with the theoretical computation of the optimum location of DV multiple stage cementers within the casing string. It gives a concrete example of the computation of final pressures at the end of each cementing stage. (Author's abstract.)

203. Crew's effort to cut production costs (own costs). J. Kowalczyk. *Nafta (Krakow)*, 1955, **11**, 143–4.—During 1954 refining costs at Jaslo were Zl. 165·02/ton (*ca* 2% below plan) and production costs Zl. 768·91/ton (0·2% below plan). Economy programme brought a harvest of ideas. Various means of cutting down fuel consumption were suggested. M. S.

204. De-emulsifier from phenol and turpentine. A. Kwaciszewska. *Bull. Polish Inst. Petrol.*, 1955, **5**, 6 (suppl. to *Nafta (Krakow)*, 1955, **11**).—This is 10 times as efficient as naphthenic acid and is used extensively in the U.S.S.R. to break brine–crude emulsions. Equal wt of phenol and turpentine are sulphonated with 92% H_2SO_4 and neutralized with Na_2CO_3. 0·04% of dry solid emulsifier at 45° C is effective. M. S.

205. Removal of water from crude oil in the oilfields. S. Rachfal. *Nafta (Krakow)*, 1955, **11**, 79–82.—Crude oil contains water as emulsion often above the permitted max of 3%. Author describes equipment which on storage favours gravitational separation: emulsion enters through a sprayer at the bottom of the tank, and on its way through a layer of water, which occupies the lower half of the tank, water globules are removed. When the level of accumulated water reaches a predetermined point, a syphon allows the surplus to be removed through a system of baffles to catch any escaping oil. M. S.

206. Washing oil wells. R. Stepek. *Nafta (Krakow)*, 1955, **11**, 131–2.—Naphthenic acids lower the interfacial tension between brine and crude in direct proportion to their concn, in particular in case of paraffinic crudes. To wash out crude from the sandstone use 5–10% soln of naphthenic acid in asphaltic crude. Twice-yearly operation in drill hole L105 doubled its production. To ensure that 50–60% of the washing fluid penetrates the rocks pressure may have to be applied. Borehole M2 of smaller daily production showed even greater relative increase. The process is fairly inexpensive. These two quoted above are the best examples of washing. Wells which have a high pressure and have not been torpedoed react best when so treated. M. S.

207. An approach to analysing ailing wells. R. Bethancourt. *Petrol. Engr*, 1956, **28** (10), B24–29.—A systematic well workover scheme is detailed. As a particular class of well work, it enables predictions regarding the success of proposed remedial action to be made. E. A. G. H.

208. The analysis of problem wells. N. J. Clark and W. P. Schultz. *Petrol. Engr*, 1956, **28** (10), B30–38.—This is based on fundamentals of reservoir engineering, and can be resolved into analyses of well pressures, water production, and gas production. Irregularities in the operation of such wells are generously illustrated by diagrams. E. A. G. H.

209. Well stimulation by fracturing. M. J. Kaufman. *Petrol. Engr*, 1956, **28** (10), B53–67.—The history of formation fracturing is recounted and mention made that profitable results have occurred in 75% of fracture treatments. Criteria for selecting wells for fracture treatment are discussed and the value of fracturing in secondary recovery and pressure maintenance operations described. E. A. G. H.

210. Water proves successful in formation fracturing. Anon. *World Petrol.*, 1956, **27** (10), 60.—Experimental work has proved that water can be used successfully as a fracturing medium with or without the addition of sand. This is known as the Riverfrac treatment, and in some cases results have been better than with oil. Advantages of the treatment are that fire hazard is reduced, and in gas wells there is no contamination of the area around the well. The high density and low visc of water reduce pumping problems. In some areas brines have been used because of swelling clays, but care must be taken to see that they do not cause undesirable reactions with connate water. C. A. F.

211. Uniformity for well-bottom pump testing equipment. W. Dubis. *Bull. Polish Inst. Petrol.*, 1955, **5**, 3–4 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—Such equipment, if uniform, can be used to test all valves in all pumps delivered from works. Max leakages permitted are tabulated. In the same issue Z. Zakrocki's investigations of radioactivity show $0{\cdot}16–0{\cdot}80 \times 10^{-10}$ curie/l in subterranean waters and $1{\cdot}11–0{\cdot}40 \times 10^{-10}$ curie/l in gases. M. S.

212. Parallel strings and pumps run in 5½-inch casing. T. C. Aitken. *Petrol. Engr*, 1956, **28** (10), B85–92.—A well that had originally dual completion through the annulus and a single string of tubing was re-completed using parallel strings of 2-inch and 1¼-inch tubing inside 5½-inch casing. The cost of the installation was $9000, representing a saving of $20,000 above the cost of drilling an additional well. E. A. G. H.

OILFIELD DEVELOPMENT

213. World offshore oil provinces. E. R. Locke and T. R. Goedicke. *World Petrol.*, 1956, **27** (10), 68.—Although most marine oil activity has hitherto been in the Gulf Coast area of the U.S.A., there is increasing interest in the worldwide possibilities of offshore areas as a supply for much of the world's future reserves. Outside the U.S.A. there have been recent developments offshore from Trinidad, Saudi-Arabia, Borneo, and in various lakes. Offshore areas which can be reached by the drills are surveyed and their oil possibilities briefly assessed. 6 areas are suggested as focal points for future expansion: the Gulf of Mexico, the Caribbean coasts of Central and S. America and the Cuban area, the coastal area of Ecuador and Peru, Mediterranean coast of Africa, Persian Gulf, and marine areas of the E. Indian Archipelago. C. A. F.

214. New six month mark set. Anon. *World Oil*, 1956, **143** (2), 76.—28,892 new wells were drilled in the U.S.A. during the first 6 months of 1956, 10·8% more than the previous record during the same period of 1955. 5019 rigs were operating at the end of June. Offshore drilling showed a 40% increase over 1955, with 217 new wells in the Gulf of Mexico off the Louisiana coast. A table shows well completions and results in the U.S.A. in June 1956 and first 6 months of 1955–56, by states and districts. C. A. F.

215. Wildcats at mid-year peak. Anon. *World Oil*, 1956, **143** (2), 74.—5996 wildcats were drilled in the U.S.A. during the first 6 months of 1956; this is a record, 12·7% higher than in the same period of 1955. Results in 1956 were not encouraging for only 11·5% of the wells were discoveries, compared with 13·3% in 1955. 526 new oilfields have been found during the same period in the U.S.A. in 1956 compared with 534 in the first half of 1955. Leading wildcatting states were Texas, Kansas, and Illinois. Tables show results of wildcat drilling in the U.S.A. for June 1956 and first 6 months of 1955 and 1956 by states and districts, and there is a summary of results. C. A. F.

216. Drilling is hush-hush operation in L.A. basin. W. T. Smith. *Oil Gas J.*, 8.10.56, **54** (75), 184.—The sound-proofing of drilling rigs in some areas of the Los Angeles basin has enabled deep tests to be carried out in old shallow fields centred in residential and industrial districts. Typical fields are the Los Angeles, Salt Lake, and Beverly Hills fields, and regulations for drilling in these areas include the complete sound-proofing of rig and related equipment, a time-limit for completion, and minimum capacity storage facilities. C. A. F.

217. Canadian oil reserves reach peak in 1955. Anon. *World Oil*, 1956, **142** (7), 278.—Despite a record high production in 1955, oil reserves in Canada increased to a record 2757 billion brl, 341 million brl more than the 1954 figure. This includes 2510 billion brl oil and 247 million brl natural gas liq. C. A. F.

218. Cardium sand potential reaches 2 billion barrels. J. C. Sproule and O. D. Boggs. *Oil Gas J.*, 1.10.56, **54** (74), 150.—The Cardium sand of Pembina and adjacent fields in Alberta is the largest known single oil reservoir in Canada (excluding the McMurray tar sands of N. Alberta). It was discovered in 1953, and to date approx 780 million brl of oil have been proved within the limits of the Pembina field and over 30 million brl in outlying Cardium fields. The geological history of the Cardium is briefly outlined, and it is shown that it forms ideal stratigraphic traps where it pinches out up-dip to the E.

It is estimated that extensions to the known area of Pembina will provide another 275 million brl of recoverable oil. Secondary recovery methods, as visualized, may add a further 500 million brl to the recovery of the field. 10 refs. C. A. F.

219. Progress and development of the Virden–Roselea field, Virden, Manitoba. R. F. Atkinson and S. Hegion. *Canad. Min. metall. Bull.*, 1956, **49** (533), 629–35.—An account of the general geology of the Virden–Roselea oilfield is given, and the drilling, completion, and production practices are outlined. The summary states that, from the investment standpoint, the field has many desirable features, such as shallow depths, high gravity oil, and availability of an adequate pipeline outlet.

In view of such features, the authors consider it probable that this field will be fully developed within the next year or two, and that there will be active exploration with a view to extending the boundaries of the field beyond the present known limits. 6 figs. M. P. T.

220. Brazil starts exploring vast region. Anon. *Oil Gas J.*, 8.10.56, **54** (75), 130.—Production in Brazil is only 7000 b.d.,

compared with a demand of 165,000 b.d., and, in consequence, exploration is being intensified. In the Amazon basin 9 wildcats have been planned for 1956 and 4 seismic parties are operating. Gravity work is also being carried out, and 6 geological parties are mapping Palæozoic outcrops on the N. and S. edges of the basin.

In Sergipe surface work and gravity and seismic exploration are being carried out, together with aerial photography. 2 wildcats are being drilled in the Maranhao–Sao Luiz area. In the Salvador basin, where are situated the Bahia fields, geophysical work and drilling have been planned for 1956.

C. A. F.

221. Foreign participation in French petroleum research. Anon. *Rev. Pétrolière*, July 1956, (981), 21–23.—Hypothetical implications of foreign participation, *e.g.* Russia with the U.S.A., are debated. Some countries *e.g.* Iraq, depend on foreign participation. France consults the U.S.A. on sp problems, but support for foreign assistance is not unanimous. Political and economic aspects of the problem are discussed. At the end of 1955 capital division between France and foreign countries was: France 82·5%, foreign 17·5%; in June 1956 France 83%, foreign 17%. The participation of foreign—British and American—interests should be balanced at 50% French, 50% foreign. This is a matter for decision at government level.

R. T.

222. Valence Petroleum Society. Anon. *Rev. Pétrolière*, July 1956, (981), 24–26.—Definite distribution of the one-million mln capital, 20% to the French Petrol. Soc. BP, 30% to D'Arcy Exploration Co, is stated. The society's objects are geological reconnaissances previously undertaken by the Bur. Petrol. Res. The Valence basin is a depression formed by terrain of Tertiary age enclosed between the Central Massif on the W., the S. extremity of Jurassic in N., and Mesozoic of the sub-alpine mountains in E. These Tertiary terrains comprise the Miocene thick sands and the Pliocene sands and clays which crop out on the greater part of the basin surface. The Oligocene terrains present the chief petroleum objective in the Valence basin. The thick, permeable Lower Oligocene, and possibly continental Eocene, well covered by Aquitanian clays, could constitute reservoirs which would be found at St Lattier at 1000 m depth. Possibilities of petroleum deposits in Mesozoic are discussed. The French Petrol. Soc. also seeks permits for Senegal. D'Arcy Exploration Co seeks participation with the above company on a 50–50 basis in British Gambia. Permits applied for and granted are stated.

R. T.

223. Society for Petroleum Prospecting and Exploitation in Alsace. PREPA. Anon. *Rev. Pétrolière*, July 1956, (981), 27–30.—The capital, 4 milliard francs, is distributed in 400,000 shares of 10,000 francs as shown, and is being increased to 6 milliards. Since 1955, by agreement with the Petrol. Res. Bur. and Pechelbronn S.A.E.M., the Soc. has taken over petroleum research in the whole Alsatian plain. It has title to 5 exclusive permits for research in Alsace, 1 in Lorraine, total area *ca* 9940 km². Details are given of perimeters of research permits requested and granted. Activities in 1955 are described, with supporting maps.

R. T.

224. A.G.I.P. story. E.N.I. oil in Italy. A. Jacoboni. *Oil Forum*, 1956, **10**, 276–8, 311–15.—Pt I. After failure of bonus system and subsidies the Government formed A.G.I.P. in 1926. Only 3 companies and A.G.I.P. worked up to the end of the war. In one year up to the end of world war II max crude production was 27,000 metric tons (1932); natural gas 1,942,270 M.c.f. (1943). Research over 20 years led to finding the first important hydrocarbon deposit, in the Po valley. Mines are inalienable property of the state. Exclusive rights of exploration and development were granted to Ente Nazionale Idrocarburi (E.N.I.). Pt II. Validity of permits and development concessions (198 covering 630 sq. miles), granted before the law constituting E.N.I. came into force, is recognized. Sicily (area 9900 sq. miles) promulgates its own mining laws. The law does not include among E.N.I's exclusive exploration rights the Quaternary strata at depths less than 3900 ft in Ferrara and Rovigo provinces. A law to clarify confusion is now before Parliament. Natural gas contributes to Italian economy by reducing fuel imports and industrial production costs.

R. T.

225. Petroleum drilling activity in 1955 in West Germany. E. Malzahn. *Erdöl u. Kohle*, 1956, **9**, 209–22.—In 1955 new oil discoveries were 11, gas deposits 4. Exploration wells in 1955 = 107 (1954 = 101). Activity shows one exploration well in E. Holstein, 4 oil discoveries between Elbe and Weser, 3 oil discoveries between Weser and Ems, one oil and one gas discovery well in Upper Rhine Valley trough, one oil and 2 gas discoveries in Molass basin. Geological maps show petroleum and gas fields, also exploration wells for N. and W. Germany. Prospecting activity is discussed by areas, and maps are given with explanatory legend. Extensive tabulations support the text.

R. T.

226. Western Germany seeks new exploration prospects. A. M. Stahmer. *World Petrol.*, 1956, **27** (10), 88.—Recent discoveries and developments in W. Germany are described. At Jan 1956 reserves were estimated at 349 million brl (*ca* 49 million tons) proven, and *ca* 114 million brl probable. Production in the first 6 months of 1956 was 66,096 b.d., compared with 61,469 b.d. in 1955. 132 rotary rigs are operating in the country, and in 1955 567 deep wells were completed, including 107 wildcats, 77 extension wells, and 383 development wells. A table gives W. German production for June 1956 and first 6 months of 1956 by fields and areas, and production and drilling footages of various companies in 1955.

C. A. F.

TRANSPORT AND STORAGE

227. Liquid methane—transport and storage. J. Burns and L. J. Clark. *Fluid Handl.*, 1956, **78**, 193–6.—The constitution, sources, and liquefaction of natural gas, the economic considerations involved, and the possible utilization of liquefied natural gas in Britain to replace coal and oil are discussed. Heavier hydrocarbons than methane can be removed from natural gas by the application of either high pressures or low temp. Low temp rather than high pressure liquefaction is favoured as the more economical technique for large-scale transportation of methane. Methane liquefaction plants exist in the U.S.A. and Russia. The transportation of liq methane in insulated tanks by barge on the Mississippi is being developed. The Joule–Thompson effect, expansion, and cascade systems of liquefaction are described, and their application to methane is considered. The special problems involved in the design and operation of ships to carry liq methane are reviewed. It is concluded that any introduction of liq methane as a fuel in Britain can happen only gradually.

D. H. A.

228. Centrifugal compressors find their place. A. L. Vaughan. *Oil Gas J.*, 22.10.56, **54** (77), 91.—Experience is given by Northern Natural Gas Co of their operation of 2 gas turbine stations through 3 winter heating seasons. 2 5700-h.p. gas-fired turbine-driven centrifugal compressors arranged in series.

G. A. C.

229. Use of radioactivity and nucleonics in the oil industry. E. W. Jones and S. B. Knowlden. *Fluid Handl.*, 1956, **80**, 240–2.—This article deals with the use of tracers for checking oil flow in an extensive full-scale pipeline system. The labelling of go-devils, scrapers, and batching pigs with sealed γ-radiation sources, usually radio-cobalt, and their detection are described. The technique by which the extent of intermixing of separate batches of oil in a pipeline can be measured by the insertion of a small slug of radioactive oil at the interface is also described. Equipment specifications and radiation safety precautions are given. D. H. A.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

230. Heat recovery in distillation installations of the petroleum industry. B. Riediger. *Erdöl u. Kohle*, 1956, **9**, 171–5.—Favourable arrangements for heat recovery become more complicated and difficult to determine as side streams from dist apparatus increase. The furnace of a crude oil dist plant for 100 tons/hr has *ca* the capacity of a 25-tons/hr steam boiler. Practical procedure for solving the problem with tolerable time loss is explained. Variations from tray to tray throughout the column and heat exchanger layout require thermodynamic calculation. Chave's proposed graphic procedure—graphs presented—is of especial value where high b.p. oil fractions are utilized in circulation (pump-around) as heat carriers. R. T.

231. Electrical power systems for refineries. G. R. Dunbar. *Oil Gas J.*, 1.10.56, **54** (74), 82.—Factors are considered in the design of an electrical distribution system in a refinery, and include type of system, sub-station voltages and burning arrangement, type of grounding, and methods of relaying. G. A. C.

232. Symposium on coolers and condensers. Introduction to general discussion. E. F. Boon. *Ingenieur, 's Grav.*, 6.7.56, **68** (27), Ch 15–24.—After a short introduction covering the economic aspects of cooler design, the author proposes a simplified treatment of heat transfer in coolers and condensers, using the film concept and the heat flow resistance, *i.e.* the reciprocal of the heat transfer coeff. 5 design factors are discussed, heat transfer, press-drop, materials of construction, type, and operation. It is possible to find the optimum condenser by combining these factors and determining the minimum operating cost graphically. 12 figs, 15 refs. (Author's abstract.)

233. Radioisotopes solve five refining problems. B. A. Fries, D. E. Hull, and S. B. Jones. *Oil Gas J.*, 8.10.56, **54** (75), 268.—5 case histories are provided by California Research Corpn on the use of isotopes to solve problems. These include measuring mixing efficiency of surge tank, segregating tar bottoms from crude stills, measuring tar entrained in dist streams, determining how much toluene in product was derived from methyl*cyclo*hexane in feed, and measuring deposits laid down in engine to test fuel-additive combinations. G. A. C.

234. Sampling particulate matter in high-pressure gas streams. R. L. Solnick. *Oil Gas J.*, 15.10.56, **54** (76), 120.—A device is described for the determination of concn of particulate matter and its size distribution in high-pressure gas pipelines.

Procedure is conventional one of removing a sample of gas containing the matter from the pipeline via a nozzle and then separating the particulate matter from the gas by a filter. Operational procedure and test results are given. G. A. C.

235. Maintenance—today's top challenge. P. S. Skaff. *Oil Gas J.*, 12.11.56, **54** (80), 176.—Maintenance experience at the Sabine River works of du Pont Co is given. Instrumentation and control take up 10% of operating investment, and 15% of the mechanical force is involved in its maintenance. Control of costs, nature of maintenance, and mechanical and electrical maintenance are discussed. G. A. C.

236. Australia : first residual oil gas plant. Anon. *Petrol. Times*, 12.10.56, **60** (1544), 907.—The Silverwater plant, Sydney, Australia, includes 3 units of Semet-Solvay high B.t.u. oil gas plant, each capable of producing 6¼ M.c.f. gas/day from residual fuel. Plant also produces benzole, toluole, xylene, and tars. Gas is mixed with existing gases produced by Amsterdam Gas Light Co. G. A. C.

SOLVENT EXTRACTION AND DEWAXING

237. Liquid–liquid extraction. Y. L. Gladel and J. Durandet. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1075–128.—Instructional course covering : liq–liq equilibria and representation thereof ; co-current extraction ; counter-current extraction, with and without reflux ; equipment. (Authors' summary.)

CRACKING

238. Building a catalytic reformer ? J. J. Hur, J. K. Deichlek, and G. R. Worrell. *Oil Gas J.*, 29.10.56, **54** (78), 103.—An outline is given for the selection of materials to be used in cat reforming. Selection depends on preclusion of hydrogen attack and resistance to hydrogen sulphide corrosion. Thus use of carbon steel is limited to equipment which will operate up to 500° F ; for temp above this low-chrome alloys are requested. G. A. C.

239. What commercial reactors look like. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (10), 211–14.—This concludes the 15-part series on reactor design. Reactors are classified into simple batch homogeneous reactors, semi-batch reactors, continuous homogeneous reactors, which include stirred tank, baffled tank, and longitudinal tubular reactors, and continuous heterogeneous reactors, which include longitudinal cat fixed-bed and cat fluidized-bed reactors. The uses, relative merits, and kinetic equations of each type are summarized. D. H. A.

240. Planning and executing a turnaround. J. S. Clarke. *Oil Gas J.*, 22.10.56, **54** (77), 100.—Use of a number of labour-saving devices in connexion with prepared lists of work to be done speed the maintenance work during shut-down of cat cracking plants. G. A. C.

241. Making ethylene. 6. More methods of recovering ethylene. H. C. Schutt and S. B. Zdonik. *Oil Gas J.*, 10.9.56, **54** (71), 120.—Low-temp absorption and fractionation, adsorption, and refrigeration systems for the separation of ethylene from other hydrocarbons are discussed, and flow sheets given. G. A. C.

242. Platforming—a means of upgrading motor fuels in natural gasoline plants. R. F. Cox and R. H. Killgore. *Oil Gas J.*, 1.10.56, **54** (74), 74.—The Southwest Gas Producing Co's experience at their Dubach, Louisiana, plant shows feasibility of Platforming in conjunction with natural gasoline condensate recovery plants. The unit has a capacity of 2000 b.d. charge

rate for production of 95 octane product with 3 cc TEL, or for 1500 hr/day charge for 98 octane product with 3 cc TEL. Tables show processing conditions and product distribution. G. A. C.

CHEMICAL AND PHYSICAL REFINING

243. New chemical sweetening process without hydrogen. P. W. Sherwood. *Erdöl u. Kohle*, 1956, **9**, 162–6.—Disulphides are less dangerous in petroleum products than mercaptans but influence O.N. unfavourably. Extraction and adsorption remove mercaptans as such. Extraction petrols possess better motive properties than those treated with oxidants. Cobalt chelate " Co-Ox " or " Salcomine " absorbs O_2 and oxidizes mercaptans to disulphides completely. Processes are given for high and low mercaptan cont. In the chelate process pH value 7 is ideal. Chelate is decomposed in acid soln. Weak alkaline reaction is permissible. Temp from 30° to 150° C have no influence on process and speed. Plumbite, hypochlorite, and copper chloride processes are discussed. R. T.

SPECIAL PROCESSES

244. Recent developments in hydrocarbon synthesis. H. Kölbel, P. Ackermann, and F. Engelhardt. *Erdöl u. Kohle*, 1956, **9**, 153–6, 225–8, 303–6.—Pt I. Gas reactions in liq medium on dispersed cat. 3 forms of gas distribution are discussed and illustrated. In the Rheinpreussen–Koppers procedure for cat gas reactions, liq columns with cat dispersed therein are preferred. Physical and chem processes are investigated relating to transport of reaction participators within the gas phase to the phase limiting surface. Vol relation liq–gas is high. Permissible cat concn in liq medium and gas loading of cat make possible, with liq column, greater conversion in unit time and referred to unit space, than other arrangements. This procedure requires no mechanical aids, since liq circulation appears necessary only in special cases.

Pt II. Fischer–Tropsch synthesis in liq medium. A semi-tech test installation based on experience gained in Pt I on Fischer–Tropsch synthesis is described. Advantages over other procedures are shown. The highly-effective reactor is simple. Cooling surface requirement for 1000 m³/hr converted $CO + H_2$ is <50 m². Synthesis gases in the ratio $CO–H_2$ as obtained most economically from solid fossil fuels are converted, in one through passage without circulation, up to 97% of $CO + H_2$ cont. From 92 to 98% of total synthesis product contains 3+ C atoms/mol. Cat is not damaged. Product is suitable for motor fuels and chem uses. The Rheinpreussen–Koppers process, by using only gases and liq, is a distinct advance.

Pt III. Synthesis of hydrocarbons from CO and steam. Further development of the Fischer–Tropsch synthesis. For this synthesis the limit ratio is important, and lies between 1–2 pt H_2O vapour/3 pt CO. CO excess incurs danger of C separation, H_2O excess causes cat weakening by oxidn. Using correct $CO–H_2O$ ratio, the synthesis runs very smoothly and leads to complete conversion in one stage. From 1 m³ CO theoretically 208 g hydrocarbons and, according to chain length, correspondingly more alcohols are formed. Comparisons are made with the Fischer–Tropsch synthesis regarding operation and economy. The Fischer–Tropsch process is advantageous where CO and H_2 can be produced cheaply, the Rheinpreussen–Koppers process from CO and steam where tech gases are available from large-scale industrial processes. R. T.

245. Separation of hydrocarbon mixtures by carbamide adducts. M. Freund and J. Báthory. *Erdöl u. Kohle*, 1956, **9**, 237–41.—A new selective method for the petroleum industry. The carbamide proportion, activators, quantity of solvent, temp, reaction time, carbamide granulation, also procedure, are important for quantity and composition of extracted hydrocarbons. Activators are necessary when natural inhibitors are present in dist. Investigation for carbamide adduct separation in the petroleum industry covers use of solid carbamide or aq soln with methanol, acetone, methyl*iso*butyl ketone, amyl alcohol, etc., as activators and benzene methyl-*iso*butyl ketone, acetone, etc., as solvents. The complex may be washed with benzene, methyl*iso*butyl ketone, cetone aq carbamide soln, etc., also decomp with H_2O or dil carbamide soln. Industrial applications discussed are dewaxing of light and heavy paraffin oil dist and obtaining ceresin from heavy paraffin oil dist or petrolatum by treatment with cryst carbamide and acetone activator in benzine soln. A method is disclosed for producing *n*-paraffin hydrocarbon preparations and new raw materials for the chem industry. Extensive tabulations. 13 refs. R. T.

METERING AND CONTROL

246. Boilaway recorder eliminates guesswork. W. H. Dudley. *Oil Gas J.*, 12.11.56, **54** (80), 174.—A resistance-type recorder covers I.B.P. and E.P. of propane and mixture of *iso-* and *n*-butane in connexion with boilaway testing and contract specifications. G. A. C.

247. Mass flowmeter for gases. J. R. Macintyre and R. G. Ballard. *Oil Gas J.*, 12.11.56, **54** (80), 159.—The new mass flowmeter works on the principle that the angular deflexion of a spring-restrained turbine is directly proportional to the mass rate of gas flow through the meter. G. A. C.

248. Automatic meters blend lube oil faster. Anon. *Oil Gas J.*, 29.10.56, **54** (78), 115.—Automatic metering facilities recently installed at Richmond, California, refinery of Standard Oil Co are described. 16 meters only are used in conjunction with a simple manifold system. G. A. C.

249. P.D. meters get the job done. D. C. McKinley. *Oil Gas J.*, 1.10.56, **54** (74), 87.—Interstate Oil Pipe Line Co have now 4 years' experience of positive displacement meters, handling over 140,000,000 brl of crude oil with reliability and accuracy. Factors in selection of meters, installation, calibration, maintenance, and economics are discussed. G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

250. The synthesis of methyl vinyl ether. Sir J. C. Ghosh, S. K. Bhattacharyya, S. N. Sen, and D. K. Chaudhuri. *Petroleum, Lond.*, 1956, **19** (10), 358–62.—Potassium hydroxide supported on active charcoal was found to be the most active cat for the synthesis of methyl vinyl ether from acetylene and methanol under various experimental conditions. The conversion passed through a max with increasing temp; the yield decreased generally with increase in space velocity and also with increase in alcohol proportion. E. A. G. H.

251. Applied chemical kinetics. XIV (contd). Chain reactions. J. C. Jungers, G. E. Limido, and J. C. Balacéanu. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1019–74.—(*Cf.* Abs. **1363**, 1956.)

ANALYSIS AND TESTING

252. Physical constants and structure of material mixtures. Modern developments of graphical–statistical methods and their different industrial application possibilities. H. I. Waterman. *Erdöl u. Kohle*, 1956, **9**, 166–9.—A graphical–statistical method—avoiding difficulties of quant analysis—is presented, with the object of clarifying the relation between chem composition and physical and mechanical properties. Wt % is replaced by C_A%, C_N%, C_P%, *i.e.* the C% present in an aromatic structure, a naphthene structure, and in paraffin (open) chains. The average No of rings/mol in the aromatic structure is denoted by R_A, in the naphthene structure by R_N, whilst R_T (index T = total) denotes the average total No of rings/mol. Accurately determinable physical const, *e.g.* n and d, should be used. Examples are given and procedure discussed for obtaining desired val with the aid of formulæ and charts. Industrial possibilities are discussed. R. T.

253. Accurate methane analyser. B. Domanski, A. Jourdan, and C. Dyrand. *Chim. Anal.*, 1956, **38**, 322–7.—Detailed description (with drawings and circuit diag) of portable combustion-type indicator in which gas flow (which can be limited, to ensure complete combustion) round filament is promoted by convection currents formed by the heated filament. 2 combustion chambers and filaments, either can be used for test or reference. Scale is linear in range 0–5% CH_4, accuracy to 0·01%. 2000 tests are possible before need for filament change. V. B.

254. Gas and plant-stream analyses in a hurry. R. J. Carroll and C. L. McGehee. *Oil Gas J.*, 22.10.56, **54** (77), 94.—Use is described of mass spectrometer and i.r. spectrophotometer techniques at Lake Charles refinery of Cities Service Refining Corpn in the analysis of intermediate and final gas and liq streams. Calculations of the analyses of a typical butane sample are shown. G. A. C.

255. Determine hydrogen content in a hurry. F. J. Piehl. *Oil Gas J.*, 15.10.56, **54** (76), 133.—A detector is described which employs strontium-90 as a source of β-rays for determination of hydrogen. Applications include determinations in cat reforming, cat hydrogenation, and solvent extraction. G. A. C.

256. Infra-red absorption analysis in the petroleum refinery—1. The application of the infra-red spectrophotometer. R. Quarendon. *Petroleum, Lond.*, 1956, **19** (10), 363–8.—A brief history of this type of analysis is given, followed by the inherent advantages of the spectrophotometer by comparison with the other general type of i.r. analyser, the continuous nil-dispersion instrument. An explanation of i.r. absorption spectra follows, and their utility in qualitative and quantitative analysis of petroleum products. Within 0·5% is the average figure quoted for accuracy. E. A. G. H.

CRUDE OIL

257. Gauging weight of mineral oils. O. Falk. *Erdöl u. Kohle*, 1956, **9**, 180–2.—Vol measurement and conversion to wt is not easy, *e.g.* with dark heavy oils. A scheme is described and illustrated for gauging accurately the wt of oil in ship bunkering and tanker loading. R. T.

258. Properties of "Czarna" and "Folusz" crudes. W. Kisielow. *Nafta (Krakow)*, 1955, **11**, 105–11, 133–9.—"Czarna" crude is asphaltic and "Folusz" is paraffinic. They have never previously been examined, and a thorough investigation has been completed. "Czarna" comes from Oligocene 400–500 m deep and "Folusz" from Eocene 250–300 m deep. The method of analysis included dist, chromatography, and ash spectrography. This is a part of general classification effort. 13 tables and 10 graphs in text. M. S.

GAS

259. Scientific and technical conference on natural gas. Anon. *Nafta (Krakow)*, 1955, **11**, 96–8.—Conference took place in Krakow on 11 and 12 Feb 1955. Several papers were read, and the following main resolutions were adopted: (1) since after 1958 supplies of natural gas will be inadequate for Polish consumption, in spite of the discovery of the Sanok fields, further drilling for gas is urgently required; (2) close attention must be paid to exploitation rate and to fall of gas pressure in gas fields; (3) gas escaping from oil-producing wells should be stored underground—investigations should be started into similar storage for coking gas; (4) extraction of gas from coalfields should be extended; (5) gas should replace petrol as far as possible; (6) special training scheme should be adopted for teaching of gas technology. M. S.

LUBRICANTS

260. Simplifying the range of lubricants. E. G. Ellis. *Petroleum, Lond.*, 1956, **19** (10), 351–3.—A mineral oil in the SAE 20 range can have a wide range of applications, and the author advocates clarifying the numbers of products by use of nomenclature such as developed by the Ministry of Supply. In this respect he discusses the recent trend to use lighter oils and multi-grades. In particular, he considers the lubrication of the automobile, as he feels that motor-car fashions must influence the pattern of usage in the larger industrial field. E. A. G. H.

261. Rheological investigations of lubricating greases. R. Krause. *Erdöl u. Kohle*, 1956, **9**, 241–5.—A new selective method for the petroleum industry. A Couette-type viscometer is used, which permits the traverse of a chosen revolution range from 0 to a max and back, thus registering at the same time the val for speed gradients and correlated shearing stress. By examples of roller bearing greases of different constitutions is shown, at various temp, how visc properties can be determined and explained as characterization for lub fat behaviour, by the traverse of a continuous revolution gradient. In place of the protracted one-point measurement follows an automatic, continuous traverse of the whole flow curve. 10 refs. R. T.

262. Rheometry of lubricating greases. H. Umstatter. *Erdöl u. Kohle*, 1956, **9**, 170–1.—The structural viscometer is applied to visc measurement of lub greases. The liq is weighed, the kinematic visc determined thereby and converted to dynamic visc. R. T.

263. Alteration of heavy duty diesel lubricants in use and the significance thereof in relation to oil-change practice and lubricating oil testing. N. Kendall, L. G. Richards, *et al.* *Schweiz. Arch. angew. Wiss.*, 1956, **22**, 261–9.—Desirability of basic additives is discussed, with particular reference to relationship between engine wear–cleanliness and available alkalinity of oil; numerous curves illustrate correspondence between these factors, desirable alkalinity level for both is approx the same. Suitably additioned oils do not deteriorate smoothly with operating time but remain satisfactory until additive concn falls below crit level, whereupon engine condition deteriorates suddenly and rapidly; rate at which crit minimum additive concn is attained can be taken as proportional to S throughput of engine. Sump drain period is function of original additive content, engine type, fuel consumption/hr, S content of fuel, lub consumption/hr, sump capacity. V. B.

264. Multigrade motor oils. J. Croff. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1161–74.—Lecture; definition, illustrations by means of various types of visc–temp curves, and nomographs relating these to V.I. Effect of shear rate on visc is discussed, and velocity gradients (pistons and crankshafts) are tabulated for 4 popular French engines at 2000, 3000, and max rev/min. V. B.

265. Synthetic lubricating oils. S. Tetril. *Nafta* (*Krakow*), 1955, **11**, 86–9.—Author considers the suitability of shale oils and lignite tars as basic materials for the production of lubricants. Only after drastic solvent refining can they be obtained from the above. With reference to *Erdöl u. Kohle*, 1948, an alternative raw material, "cogazine," b.p. 280°–320° C, is suggested. It is chlorinated at 40°–120° C to the extent of 17–31% and used to alkylate naphthalene. Complete analysis of end products is given. M. S.

266. Using modern detergent lubricants. Anon. *Gas Oil Pwr*, 1956, **51**, 235.—To overcome the difficulties experienced with emulsified lubricants in sight-feed indicators, a new type has been designed, in which the amount of oil passing through the pump is indicated by oil flow from a drip tube enclosed within a Perspex sight chamber. A vacuum inside the latter controls the flow, and the oil then passes to the inlet port of the cyl of the pressure pump. Indicators are available for pressure ranges up to 500, 1500, or 6000 p.s.i. H. C. E.

267. Friction reducing additives. Anon. *Gas Oil Pwr*, 1956, **51**, 226.—Dextrol Concentrate 905 withstands friction and stress to a greater extent than conventional lubricants. Tests on a lub oil, untreated and containing 10% additive, in the Timken machine, showed that with the additive wear was barely noticeable and seizure occurred only sometimes at 500 lb (max) load; with the untreated oil severe wear was obtained, and seizure always occurred at less than 500 lb load. The additive is liq between −28° and 270° C.
H. C. E.

BITUMEN, ASPHALT, AND TAR

268. Recent knowledge of Hungarian bitumen. L. Vajta. *Erdöl u. Kohle*, 1956, **9**, 233–6.—The most important raw material for Hungarian bitumen production is Nagylengyel petroleum (bitumen *ca* 60%). Production is by vac dist or vac dist + oxidn. Dist bitumen has pen index +0·5, high-vac up to +2. Blown bitumens have pen index up to +7. Dist bitumen can be used in road tar mixtures. Since the crude oil contains paraffin, up to 2% is contained in softer bitumens. Its effects are checked rheologically. According to Traxler the lower val proves not only gel structure, but can indicate paraffin structure, which also establishes high heat-sensitivity. For characterization of the bitumen at different temp, deformation rate v as a function of shear stress τ was measured. Log v as a function of log τ is a straight line. By further log-diagram development relationship to visc can be evaluated. Instead of paraffin cont it appears more suitable to evaluate paraffin and asphaltene cont in relation to rheological properties. 23 refs. R. T.

269. Bituminous products in corrosion protection and insulation in railway construction. F. Crelerot. *Schweiz. Arch. angew. Wiss.*, 1956, **22**, 294–300.—Discussion of protective coating requirements of rolling stock. Bituminous products are preferable to synthetic resins or to fatty-base materials; characteristics of bituminous paints are considered. Bitumen coatings can either be applied in numerous thin films (0·2–0·3 kg/m²) or as single thick coat (2–3 kg/m²); thick solvent-based coating is preferred. Problems of thermal and acoustic insulation of rolling stock are outlined. V. B.

270. Action of and experiences with cationic emulsions in road construction. H. Kresse. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (7), 267–70; **7** (8), 301–5; **7** (9), 347–50; **7** (10), 382–3.—In Pt I the basis of the nature of acid cation-active bitumen emulsions compared with normal basic anion-active is discussed. Anion-active type emulsions with alk reaction are suitable for basic stones, but with acid stones bitumen films do not adhere satisfactorily. Cation-active "acid" is more suitable. In describing the basis of emulsion production, electrolytic behaviour of emulsifiers is emphasized, especially in relation to stability and breakdown. Besides anion- and cation-active emulsifiers, non-ionogenic and amphoteric emulsifiers are usable for the same purpose.

Pt II. Determination of the electrolytic character of bitumen emulsions is investigated and a procedure proposed. Advantage is taken of the technique of production and use of cation-type emulsions in other spheres. Discrimination and evaluation of the different emulsion types is drawn from relevant technical literature.

Pt III. Information is given on available domestic and foreign literature on cation-active emulsions. Their introduction is very recent. Advantages of these emulsions are emphasized in comparison with anion-type. Valuable suggestions are obtained by bitumen emulsion producers from new patents issued.

Pt IV. Experiences on the practical use of cation-active emulsions from abroad are described. Information on cation-active emulsions presented at the 10th International Road Congress in Istanbul is discussed. The French and Dutch reports bring some relevant data with reference to the special advantages of these newly-developed bitumen emulsions. Their advantages compared with normal emulsions with acid stones are shown. Further, attention is drawn to industrial reports, according to which the production of cation-active emulsions in France constitutes an important portion of the total bitumen emulsion production. 13 refs. R. T.

271. Group analysis of asphalts. O. Geschwind. *Bull. Polish Inst. Petrol.*, 1955, **5**, 5–6 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—Using benzene and acetone asphaltenes, resins and oil were separated. A series of asphalts was examined, and the soft. pt and pen were correlated to relative proportion of these 3 components. When asphalt is oxidized, longer chains are formed from oil and resin. M. S.

SPECIAL HYDROCARBON PRODUCTS

272. The modern chemistry and analysis of waxes and wax products. J. H. Skellon. *Paint Technol.*, Aug 1956, **20** (227), 287; Sept 1956, **20** (228), 328.—This paper is a condensed version of 3 lectures given at Acton Technical College. Waxes may be classified by composition or origin. In Pt 1 the principal chemical components of waxes are considered; these are hydrocarbons, *i.e.* paraffinic hydrocarbons from tetradecane to heptacontane and olefinic hydrocarbons from cetene to dotriacontene, wax alcohols, wax acids, and wax esters. The composition of the following important waxes is considered—ozokerite, montan, petroleum, candelilla, japan, beeswax, carnauba, and various synthetic waxes.

Some of the techniques used in the chemical analysis of waxes and wax-containing materials are reviewed in Pt 2.
D. K.

DERIVED CHEMICAL PRODUCTS

273. Obtaining paraffin from petrolatum. II. R. Rigamonti and M. Panetti. *Riv. Combust.*, 1956, **10** (9), 597–617.—Research has continued on the obtaining of paraffins from petrolatum by the formation of urea adducts with a view to minimizing the consumption of solvents and heat requirement.

The cycle consists of avoiding volatile solvent in the stage when the adduct is formed by the addition of urea and restricting its use to the washing step only. First and foremost, operating conditions were studied to obtain with this cycle an addition cpd having satisfactory yields, at the same level as that achieved when employing naphtha as solvent. The results attained were positive, although the reagent mass had to be diluted with dewaxed petrolatum from previous processes in order to make it sufficiently fluid. Then a theoretical study and practical experiments were made of different backwashing methods by decantation and filtration, enabling the quantity of solvent employed to be reduced. When using naphtha the best results are obtained with the filtration method. Finally, attention was turned to the use of a blend of cresols as a washing solvent, having the characteristic of being completely soluble with petrolatum and paraffins when hot, and only partially miscible when cold, so that it offers the advantage of almost total recovery by simple cooling and decantation instead of dist. (Authors' summary.)

MISCELLANEOUS PRODUCTS

274. Burning fluid coke. O. Craig and E. H. Smith. *Mech. Engng, N.Y.*, 1956, **78** (10), 921.—Brief review of the fluid coking process, together with a description of the properties of the fluid coke, is given. An appraisal of the suitability of a furnace for the burning of fluid coke is made. Test results are presented. D. K.

CORROSION

275. Preventing corrosion in tankers. J. S. Gerrard. *Petroleum, Lond.*, 1956, **19** (10), 347–50.—The results of corrosive attack on tankers are described, together with the principal methods of corrosion control. Cathodic protection was introduced in the test tanker, full details being given of installation, and mention made of the effectiveness of the method on inspection. E. A. G. H.

276. Prevention of corrosion in processing Middle East crudes. W. A. Derungs. *Oil Forum*, 1956, **10**, 298–300.—Total S in Middle East crudes is *ca* 7%, in extreme cases 10%. By using suitable neutralization systems and modifying operating conditions, use of mild steels is possible. Relatively low-temp corrosion (below dew-pt) occurs in run-down systems, resulting from hydrolysis of $CaCl_2$ and $MgCl_2$ into HCl, and S corrosion at high temp (above dew-pt). In H_2O absence, S in oil is most corrosive as H_2S and mercaptans. In H_2O presence, SO_2 corrosion occurs below the dew-pt of the corrosive medium. $H_2S + SO_2$ causes serious corrosion. Neutralization by injecting NaOH soln, 3 wt % mixed with crude oil, into the feed line between heat exchangers and furnace + injection of a 3 wt % aq-NH_4OH soln in the overhead line is efficient and economical. Recommendations for structural material selection based on this procedure are given. R. T.

277. Cathodic protection at Lake Charles. G. H. Hill. *Oil Gas J.*, 15.10.56, **54** (76), 138.—Systems installed in 1954 for cathodic protection at Cities Service Refining Corpn's Lake Charles refinery are described. Lead-sheath power and control cables are protected with one system and underground piping and storage tanks use another. Tests on cables and tank-farm areas are described, and construction details for systems given. G. A. C.

278. New chart for calculating power costs. Anon. *Oil Gas J.*, 8.10.56, **54** (75), 273.—A chart speeds up calculations concerning combinations of anodes and spacings for cathodic protection insulation. G. A. C.

279. Pipeline survey and planning. 1. G. I. Russell. *Pipes & Pipelines*, 1956, **1** (1), 17–20.—Pipeline corrosion—hitherto met by increased wall thickness—is now a major problem. Corrosion-resistant materials and modified design, with expert advice based on initial survey of terrain and all contributory factors, is essential. Progressive approach by providing adequate int and ext coatings and cathodic protection is discussed. R. T.

ENGINES AND AUTOMOTIVE EQUIPMENT

280. Starting diesels at low temperatures. Anon. *Gas Oil Pwr*, 1956, **51**, 231.—This device uses the same fuel as the engine, and is fitted horizontally in the inlet manifold. In operation a small quantity of the fuel is admitted at a controlled rate to a heating chamber by actuating a magnetic valve. It becomes vaporized, and a further heating coil raises the vapour temp to ignition point. When the engine is cranked, air enters perforations in the surrounding shield and the burning mixture is drawn into the cyl, thus igniting the injected fuel. H. C. E.

281. A symposium of papers on recent developments in marine diesels. Various. *Trans. Inst. Mar. Engrs*, 1956, **68** (10), 365.—This symposium includes the following papers: Turbocharging of Burmeister and Wain Opposed Piston and Poppet Valve Engines, by H. Carstensen; Recent Developments in Marine Diesels (Doxford Engine), by P. Jackson; Some Aspects Concerning the Supercharging of Existing Two-stroke Marine Diesel Engines, by W. Kilchenmann; Two-stroke Marine Diesel Engines with Uniflow Scavenging and Constant Gas Pressure Turbocharging, by F. G. van Asperen and H. Schultheiss. Discussions on the papers and authors' replies are included. D. K.

MISCELLANEOUS

282. Foreign nations and free enterprise. A. Wiley. *Oil Forum*, 1956, **10** (10), 337.—The Italian Parliament, by highly restrictive legislation, makes foreign capital investment virtually impossible. Venezuela welcomes foreign capital which will flow in, treating it in a fair, friendly, sound, equitable manner. R. T.

283. Big Government and offshore oil. Let's get rid of "Red tape." S. M. Groom, Jr. *Oil Forum*, 1956, **10**, 270–1.—Governmental laws and regulations, both State and Federal, have hindered progress. A Supreme Court order forbids both Federal and Louisiana State Governments to lease or begin drilling of new wells in disputed tidelands, except by agree-

ment of the parties. Warning areas for air-to-air gunnery and the quarrel between Louisiana and the U.S.A. limit offshore development. Co-operation between Federal and State Governments is necessary. R. T.

284. Flexibles—arteries of industry. J. V. Klein. *Pipes & Pipelines*, 1956, **1** (1), 26.—A general review of problems involved in selection of a particular flexible for a sp purpose, *e.g.* oil, air, fuel, water, bitumen, and food liq conveyance. R. T.

285. Plastic pipes and tubing for structural applications. Anon. *Pipes & Pipelines*, 1956, **1** (1), 21–3.—Applications and limitations of plastic pipes are discussed. Their value lies in corrosion resistance to chem and electrolytic action. Their org nature renders them H_2O-insol, therefore non-ionizing, and almost completely incompatible with many inorg substances. Cellulose acetate butyrate is used for crude oil and raw gas conveyance in oilfields. R. T.

286. Air pollution and the petroleum industry. H. R. Crabaugh. *Oil Forum*, 1956, **10**, 302, 317–18.—Substances from petroleum production, processing, marketing, and consumption react with oxidants in presence of sunlight to form smog. 300 tons of hydrocarbons are emitted to the atm every 24 hr from petroleum industry sources in Los Angeles County; 1300 tons are kept out of the atm. In absence of wind, atm conditions are unfavourable to dispersion. Chief sources of contamination are refinery and allied operations, which are discussed. From April 1951 to April 1953 only sp sources of contamination were controlled, mostly voluntarily. Further controls in 1953 reduced hydrocarbon losses from storage tanks from 145 tons/day to 20 tons, at a cost of $10,000,000. Pollution details are tabulated. R. T.

287. Correlating muds of to-day as clue to the habitat of ancient sediments. Anon. *Oil Forum*, 1956, **10**, 274–5.—Illustrated description of aqualung diving technique application by Magnolia Petroleum Co to underwater research in Gulf of Mexico. R. T.

288. Science and technique in Soviet Union—Results of year 1954 and objectives for year 1955 in petroleum industry. N. K. Baibakov. *Nafta* (*Krakow*), 1955, **11**, 91–2, 114–15.—Plans for 1954 were completed between 22 and 26 Dec. The rate of increase of production was higher than in 1953. As a result of intense geological activity fresh deposits were discovered in the Volga–Urals region in Tartary and Baskiria near Kuybishev, Molotov, and Stalingrad. On the whole, 60% of oil comes now from the E. regions. Repressurizing and flooding helped to keep up the yield of older wells. Some hydraulic shooting gave astonishingly good results. Over the whole country turbo-drill was used to the extent of 65% and, in the newly-discovered areas, 95%. Formation water is used in place of muds. Several crews drilled 10–12 km/rig/year in the new regions and 25–28 km/rig/year in Baku. General improvements in refining methods were made in some refineries. Several stripping plants were built and a few gas pipelines and oil pipelines were completed. The administrative structure has been simplified and some bureaucratic form filling has been cut out. This effort has been made possible due to great loans from the state, but there are shortcomings, primarily in drilling, due to lack of co-ordination. In 1955 stress will be laid on better liaison to cut the time-consuming wait for erection or other work to be completed. Other shortages are evident in logging and geological work. In some regions secondary exploitation is lagging, and discipline must be tightened. Slight inefficiency in refining industry is due to slow application of scientific progress in practice. Water settling in Kuybishev refinery is not satisfactory. Constant struggle to cut down production costs must be continued. Natural gas industry is still lagging, and vast amounts of gas are still being allowed to escape in the newly-developed fields. Plans for 1955 include gas pipelines, refineries, automatic operations, and technological improvements to lower the costs. New drilling techniques and better muds must be used everywhere. Greater efficiency and greater economy must be achieved by all branches. M. S.

289. For a rise in oil production in 1955. S. Dutka. *Nafta* (*Krakow*), 1955, **11**, 75–9.—Report of a meeting of the Workers' Party representatives, trade unions, Ministry, Polish IP, Mining and Foundry Academy, and all other interested parties. Author presents a summary of achievements in 1954 and hopes for 1955: total effort of the petroleum industry in 1954 was 4·3% above 1953 and 3·2% above plan for 1954. In individual branches achievements were as shown: natural gas, 12·3%; raw gasoline, 17·1%; efficiency/man, 15·9%; wages, 11·8%; secondary production by repressurizing, 9% (all above 1953). Although 13·5% fewer wells were subjected to deepening, production by this method rose by 4·5%. Accidents fell by 16·2% and working hours by 5·8%. Educational activity rose by 64·7%, and production costs fell in all sections. On the other hand, natural production of crude fell below planned figures, mainly due to lack of scientific control, although higher production was proved possible under IP supervision. For 1955 it is planned to arrest natural fall by keeping all well records and logs. IP will train operators, and secondary production should rise by 25%. Greater co-operation between petroleum industry and its suppliers must be established. M. S.

290. Own costs (of production) in refining industry in 1954. L. Zurowski. *Nafta* (*Krakow*), 1955, **11**, 93–6.—No longer is it enough to satisfy oneself by saying that the plan has been completed in time. The costs are much too high and, in spite of repeated efforts to cut them, are rising still. A large share of the responsibility lies on the continued use of old inefficient refineries, and a large share is due to lack of co-ordination between refineries and foreign suppliers of crude, the nature of which varies. In 1953 cost/tonne refined was Zl. 168·54, and in first quarter of 1954 showed a rise to Zl. 170·60. Over the whole of the year cost fell to Zl. 150·37. Various economies in power consumption are suggested, and the need to cut refining losses is also imperative. New refineries will help to improve quality of final products. M. S.

291. Works' agreements on competition. W. Swidrak. *Nafta* (*Krakow*), 1955, **11**, 117–18.—These were arranged between staff and management with a view to speeding up rate of production. As a reward for extra effort, canteens, first-aid posts, etc., were promised to the workers, but often promises were not kept. M. S.

292. Petroleum and atomic energy. R. Glaser. *Nafta* (*Krakow*), 1955, **11**, 111–14, 139–41.—Article summarizes how radioactive elements (natural and artificial) are being used to help and to compete with petroleum. M. S.

293. Change of mining laws and their application to petroleum industry. A. Waliduda. *Nafta* (*Krakow*), 1955, **11**, 118–19.—Development of laws since 1576 is briefly traced. Minerals in general, and bituminous materials in particular, passed from the monarch to the landowner and back several times. The latest relevant legislation was that of the Austro-Hungarian Empire, of whose territory Galicia formed part up to 1918. This law (of 1884, amended 1908) was in force until 1953, even though the state took over the ownership of all deposits in 1946. In 1953, the Ministry of Mines took over all exploitation and exploration, whilst Ministry of Industry took over all refining. In 1954, all this passed to the Office of the Prime Minister. The decree includes safety rules which have the force of law. M. S.

294. Ten years of publication of *Nafta*. J. Wojnar. *Nafta (Krakow)*, 1955, **11**, 125–8.—First issue came out on 25 June 1945 in Krosno, published by the Polish IP. There were 750 copies printed. In 1951 the State Technical Publications took over *Nafta*, then printing 1350 copies. By 1954 there were only 1100 copies issues. Published since then by Mining and Foundry Publications, its issues vary between 1100 and 1200 copies. It consists of technical and popular sections, with other small permanent features. 34 copies are exchanged with foreign publications, of which 14 come from the West. 11·8% of its pages contain articles on chemistry and refining, 9·9% each on drilling and geology, 20% on organization and economic matters, 7·9% on exploration, and 9·7% on statistics. M. S.

295. Current news. Anon. *Nafta (Krakow)*, 1955, **11**, 99–100.—Includes data on progress towards completion of plan: drilling, 119% approx; production, 100% approx; refining, 101·2% of crude throughput and 104·1% of finished products. Geological work has been concentrated under 2 regional enterprises in the S. and one, for the N., centred on Krakow. Geophysical drilling work is concentrated in a unit under the Ministry of Mines. M. S.

296. U.S. Bureau of Mines world statistics. Anon. *Petrol. Times*, 12.10.56, **60** (1544), 911.—Crude oil production, imports, exports, refinery runs, and refinery output of major products in 1955 are tabulated. G. A. C.

297. Petroleum Division of the American Chemical Society. Anon. *Petrol. Times*, 12.10.56, **60** (1544), 917.—Abstracts are given of some 30 papers presented at Dallas, Texas, April 1956. G. A. C.

298. Research Council for Alberta report for 1955. Anon. *Nature, Lond.*, 1956, **178**, 679.—The 36th annual report refers to increased emphasis of basic geological research and survey. Studies of the kinetics of thermal degradation or maturation for the removal of V or Ni from McMurray oil show that geological time has been too short to account for the observed maturation of oils in Alberta, and suggest that cat play a part in the formation of crude oil.

Chromatography of heavy oils showed that extraction methods for removing S from oil-sands oil were unsatisfactory, and catalytic decomposition or oxidn is considered as a means of desulphurization.

In the field of natural gas, the partial oxidn of *n*-butane, the production of C black, and the high-temp pyrolysis of butane have been studied.

A combination of i.r. and elementary analysis indicated the relation between humic acid and the rank of coals, and studies of the oxidn of phenols to humic acid indicate that by this means naphthenic acids of the type known to occur in coal and petroleum can be formed. H. C. E.

299. Important resolutions of the Technical Mining Council of Ministry of Mines. Anon. *Nafta (Krakow)*, 1955, **11**, 119.—The Council accepted the proposed 5-year plan for refining and for exploratory work, as well as for scientific work, of the Polish IP. In the Polish lowlands, drilling to the extent of one million m is to be carried out. Though plans for investigations in these areas existed since 1951, shortage of pipes and money prevented their execution. For the success of the 1956–60 plans it will be necessary to buy deep drilling equipment. M. S.

300. Italian oil and gas industry. V. S. Swaminathan. *Engineer, Lond.*, 1956, **202**, 312–14, 344–6.—Discovery of a series of natural gas fields in the Po Valley region from 1946 to 1952 has led to rapid increase in methane usage; whereas in 1938 natural gas constituted less than 1% of domestic energy consumption, in 1954 the figure rose to 11%. The Italian state organization A.G.I.P. accounted for 95×10^9 ft³ of methane in 1954, and now has a network of gas lines extending over 2300 miles. Apart from thermo-industrial purposes, electricity generation, domestic uses, and road transport, natural gas is finding increasing use as a raw material for the chemical industry. Methane is to be converted by partial oxidn into hydrogen and acetylene, and thence into nitrogenous fertilizers and synthetic rubber. A large chemical plant is to be completed at Ravenna (60 miles S. of Venice) for the production of 350,000 metric tons p.a. of synthetic rubber and a like quantity of nitrogenous fertilizers. Construction of several petrochemical units based on steam pyrolysis of naphtha and gas oil is also proceeding at the Ferrara factory of the Montecatini Co. This plant is designed for a capacity of 56 million lb/year of C_2 and C_3 olefins, and in addition to polyethylene will produce polystyrene, acetone, alcohols, ethylene oxide, and glycols. Indigenous production of crude oil at *ca* 100,000 tons p.a. (due largely to discovery of oil of 34° API gravity at Pescara in the Abruzzi area of E. Italy in Feb 1955) represents only *ca* 0·5% of crude runs to stills. The main refineries are mostly owned by Italian affiliates of major international oil companies, including Standard Oil Co of New Jersey (STANIC) at Leghorn and Bari, with a combined annual crude capacity of 3·5 million tons, Shell (INPET) at La Spezia, 1·5 million tons, British Petroleum (IROM) at Venice, 1·5 million tons, Socony Vacuum at Naples, 3·3 million tons. In addition, there are the Condor refinery at Rho near Milan of 2 million tons capacity, Aquila at Trieste, 0·9 million tons, and *ca* 20 smaller refineries, each with a capacity less than 0·5 million tons p.a. Most of the crude oil processed is Middle East, and about half the refined products are exported. Details are given of the comprehensive range of processes which are operated. Italy's first platformer of 2000 b.s.d. capacity is due to be commissioned at Venice this year. Sicily produces *ca* 75,000 tons of oil p.a., and refines over 2 million tons. 7 photographs of plants and map of gas fields and pipelines in Po Valley. A. C.

BOOK REVIEWS

Geophysical Case Histories, Vol. II—1956. Ed. Paul L. Lyons. Tulsa, Oklahoma: Society of Exploration Geophysicists. Pp. xiv + 676. $7.00.

Like Vol. I, published in 1948, this is a collection of papers by many different authors having as their common factor an interest in the discovery, or attempted discovery, by geophysical methods, of hidden geological structures. Apart from this common theme, Vol. II shows an important change of emphasis and broadening of outlook when compared with Vol. I. The earlier collection dealt with only four cases outside the U.S.A., in a total of 60 papers. The present volume has 17, from all parts of the world, out of a total of 53 papers. Furthermore, nine of the new papers deal with the use of geophysics for other than oil exploration purposes, whereas there were only two such papers in the first volume. This still leaves oil and gas fields, 47 of them in all, as the preponderant topic.

These case history volumes are much too full of material to invite or even permit digestion at one sitting. Like the great classics in other branches of literature, they best repay selective study. The exploration man who wishes to broaden and deepen his understanding of geophysics is

recommended to start by going through the list of contents. This is sub-divided according to the type of problem, *e.g.* salt-domes, reefs, anticlines, stratigraphic traps, etc. A reference then to the abstract of the paper will indicate whether the case is one that is likely to be instructive to the reader concerned.

Some of the cases are short and sweet, like the South Cayuma (California) field, picked up by a reflection reconnaissance line in late June 1948 and brought in by the first test well at the beginning of May 1949. Others recount long years of disappointment, with persistence finally rewarded. In this connexion it is instructive to note that despite the use of geophysical methods in every case, one in every three of the fields gave a dry hole at the first test.

Of particular interest to European readers are the case histories of the Parentis, Lacq, and St Marcet fields in the Aquitanian basin, and of the Eldingen field in Germany. To go any further in mentioning particular papers or in attempting generalizations would be beyond the scope of this review. It should already be clear that the variety and abundance of the material in this volume makes it most unlikely that anyone interested in oil exploration could fail to find something of interest and value to himself in it.

L. H. T.

Mass Transfer Operations. R. E. Treybal. New York, London: McGraw-Hill, 1955. Pp. 666 + lx. 71*s.* 6*d.*

The book is intended to provide a course of undergraduate study in those chemical engineering unit operations which involve mass transfer by diffusion. A knowledge of fluid dynamics and heat transfer is assumed, and the text contains references to the literature which will enable the post-graduate student to extend his reading. The book is divided into five parts; Pt I, Diffusion and Mass Transfer, contains four chapters dealing with molecular diffusion in fluids, diffusion in turbulent flow, diffusion in solids, and interphase mass transfer. Pt II, Gas–Liquid Operations, is also of four chapters, which deal with equipment for gas–liquid operations, humidification operations, gas absorption, and distillation. Pt III, Liquid–Liquid Operations, contains one chapter on liquid extraction, and Pt IV, Solid–Liquid Operations, contains three chapters dealing with adsorption and ion exchange, drying, and leaching. Pt V, Contact of Miscible Phases, contains a chapter on the less conventional operations and includes a brief treatment of dialysis, gas diffusion, and atmolysis or mass diffusion.

The book has been planned to introduce the student to the basic design methods of each operation and to stimulate his interest by well-chosen numerical examples. The theoretical introduction to the subject, given in Pt I, is simplified by confining the treatment of interphase mass transfer to the Whitman Lewis two-film theory, and is followed by a generalized discussion on equilibrium diagrams, stagewise calculations, and graphical presentation of data.

Pt II, on Gas–Liquid Operations, is introduced by a chapter on the equipment used for gas–liquid contacting, and includes a discussion on the design of bubble-cap plates, spray towers, packed towers, and on the properties of various tower packings. Sufficient data are given to illustrate the design calculations given in the text. Subsequent chapters on humidification, absorption, and distillation cover the application of theory to the specific operation under discussion and develop design methods for these processes. A similar pattern is followed in Pts III and IV. Naturally the individual chapters, particularly that on liquid–liquid extraction, present a somewhat condensed appearance by comparison with the various monographs on the individual subjects. The subject matter is, however, clearly presented and covers more than the normal content of a degree course. A minor criticism might be made on the grounds that the author has attempted to cover too much in these particular subjects, but if the book is to serve post-graduate courses in addition to undergraduate work this must be accepted.

Throughout the text the author has made use of illustrative examples worked out in complete detail. Many of the examples are taken from industrial practice and provide a means of maintaining the student's interest and widening his experience. The collected questions at the end of each chapter provide further opportunity for design practice. The text is well illustrated, the phase diagrams and graphical correlations being produced clearly to enable easy use by the student. Each chapter contains a selected bibliography to permit the more advanced student to extend his reading. The book is well indexed and excellently produced.

F. M.

The Canadian Petrochemical Industry. Chemical Division, Shell Oil Company of Canada. Toronto: Ryerson Press, 1956. Pp. xi + 154.

This is a book with 10 chapters describing 15 petroleum chemical plants in Canada. Most emphasis is given to the historical development and techno-commercial background of each plant. The processes employed are described somewhat sketchily, but there are literature and patent references.

Almost all the Canadian petroleum chemical plants in operation are described; some non-petroleum chemical operations and some processes based on imported petroleum chemicals are also included.

The book is well printed and produced, and no significant misprints have been noticed. It appears to have been produced principally to impress Canadian industry with the virile growth of the petroleum chemical industry. This is certainly impressive, for it started from nothing in 1942 to an investment of about $200 million in 1956. But nowhere in this book has the opportunity been taken of totalling the achievements and capacities of the plants described.

R. F. G.

Impurities in Petroleum. Petrolite Corporation Laboratories. Long Beach, California: Petreco, 1956. Pp. 74. $2.00.

In this clearly-printed and well-arranged manual, the authors have endeavoured with no mean success to present the problem of impurities in petroleum products in an interesting as well as instructional manner. The subject matter is easily readable, and the salient features of the problem are covered from both theoretical and practical standpoints. The manual is not, however, a text-book, nor is it intended to be fully comprehensive; its object is to bring to the notice of the worker the complexity of the problem and to suggest methods by which the quantitative determinations of the many and varied impurities may be achieved.

The manual is divided into two distinct sections, the first and smaller of which deals with the nature of impurities, which are classified under the general headings of oleophobic and oleophilic types, and the effects which they may have on petroleum products, as well as refining equipment; this section contains several comprehensive tables detailing the variations which occur in crudes from various oilfields.

The second section is devoted to a fairly detailed description of methods of analysis for impurities, particular attention being paid to the extraction of the impurities prior to analysis. The methods of analysis are clearly described, and the calculation of results is fully explained.

A fairly comprehensive bibliography is included at the end of the manual.

H. E. B.

Methods for Reducing the Effect of Barometric Pressure in Measurement of Octane Number. B. R. Seigel. ASTM Special Technical Publication 186. Philadelphia, Pa. U.S.A.; ASTM, 1956. Pp. 28. $1.50.

This publication was prepared as a joint undertaking of the API, ASTM, and the NBS.

Knock ratings made by the ASTM Motor, Research, and Aviation methods are affected by barometric pressure, and tests in the range 21–30 in. Hg indicated that some means of resolving the effect of barometric pressure was needed. Pressurized induction and exhaust systems were tested, and inlet temperature and compression ratio were adjusted to produce more uniform compression temperature–density relationships regardless of barometric pressure. The final results are presented in the form of tables of operating conditions that will lead to substantially the same octane number when operated at any atmospheric pressure between 21·0 and 30·5 inches of mercury absolute.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

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030 BRITISH STANDARDS INSTITUTION. Annual report 1955–6. London, BSI, 1956. 259 p.

030 DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. *Fuel Research Board.* Report of the Fuel Research Board with the report of the Director of Fuel Research for the year 1955. London, HMSO, 1956. 75 p.

030 GAS COUNCIL. Seventh report and statement of accounts for the year ended 31st March 1956. London, HMSO, 1956. 199 p.

030 UNITED STATES. BUREAU OF MINES. Health and safety activities of the Bureau of Mines, fiscal year 1955, by James Westfield. Washington, D.C., U.S. Dept. Interior, 1956. 23 p. (Information circular 7732.)

*080 COUNCIL OF BRITISH MANUFACTURERS OF PETROLEUM EQUIPMENT. Classified list of equipment and services supplied by members of the Council of British Manufacturers of Petroleum Equipment. London, CBMPE, 1956. 80 p.

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090 ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION. Europe's growing needs of energy: how can they be met? Paris, OEEC, 1956. 120 p.

090 ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION. Some aspects of the European energy problem: suggestions for collective action, report prepared by L. Armand. Paris, OEEC, 1955. 61 p.

140 SHWADRAN, B. The Middle East, oil and the great powers. London, Atlantic Press, 1956. 512 p.

200 UNITED STATES. BUREAU OF MINES. Analyses of crude oils from some California fields, by E. L. Garton and C. M. McKinney. Washington, D.C., U.S. Dept. Interior, 1956. 53 p. (Report of investigations 5249.)

210 AMERICAN SOCIETY FOR TESTING MATERIALS. Determination of the shear stability of non-Newtonian liquids. Philadelphia, Pa., ASTM, 1955. 12 p. (STP 182.)

210 GARNER, W. E. *ed.* Chemistry of the solid state. London, Butterworths, 1955. 425 p.

210 INSTITUTE OF PETROLEUM. Molecular spectroscopy: report of a conference organized by the Spectroscopic Panel of the Hydrocarbon Research Group of the Institute of Petroleum and held in London 28–29 October 1954, edited by G. Sell. London, IP, 1955. 242 p.

*210 ISHIHARA, S. Tests for colour blindness. 11th ed. Tokyo, Kanehara Shuppan, London, Lewis, 1954. 27 p. + charts.

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210 WOLFE, H. C. *ed.* Temperature: its measurement and control in science and industry, Vol. 2. New York, Reinhold, London, Chapman and Hall, 1955. 477 p. Papers presented at the Third Symposium on Temperature, Washington, D.C. October 28–30, 1954 sponsored by American Institute of Physics, National Bureau of Standards and Office of Ordnance Research, U.S. Army.

220 FERRIS, S. W. Handbook of hydrocarbons. New York, Academic Press, 1955. 333 p.

260 AMERICAN SOCIETY FOR TESTING MATERIALS. Evaluation of insulating oils—European developments: a symposium held Cleveland, Ohio, November 17, 1954. Philadelphia, Pa., ASTM, 1956. 72 p. (STP 172.)

310 AMERICAN CHEMICAL SOCIETY. *Div. Petroleum Chemistry.* Chemistry in the exploration and production of petroleum: symposium, Dallas, Texas, April 8–13, 1956. Washington, D.C., ACS, 1956. 122 p.

340 CARMAN, P. C. Flow of gases through porous media. London, Butterworths, 1956. 191 p.

420 BRITISH PETROLEUM CO. LTD. Core analysis manual. London, BP, 1955. *In progress.*

420 BRITISH PETROLEUM CO. LTD. Drilling fluids compendium. 2 v. Vol. 1. Routine testing of drilling fluids and drilling fluid additives. Vol. 2. Fundamentals of drilling fluids. London, BP, 1955. *In progress.*

420 TULSA PUBLIC LIBRARY. Core analysis. Tulsa, Okla., Public Library, 1948. 13 p. (Petroleum bibliography no. 24.)

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420 TULSA PUBLIC LIBRARY. Well logging methods. Tulsa, Okla., Public Library, 1948. 14 p. (Petroleum bibliography no. 26.)

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590 TULSA PUBLIC LIBRARY. Salt water disposal. Tulsa, Okla., Public Library, 1947. 13 p. (Petroleum bibliography no. 5.)

610 SUN OIL COMPANY. Analysis of world tank ship fleet. December 31, 1955. Philadelphia, Pa., Sun Oil Co., 1956. 8 p. + tabs.

610 TEXAS UNIVERSITY. *Petroleum Extension Service.* Oil pipe line measurement and storage practices. Austin, Texas, Texas University, 1955. 144 p. (No. 1000.) Volume 3 of the series on Oil Pipe Line Transportation Practices.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

301. West Texas eyes Irion. F. J. Gardner. *Oil Gas J.*, 5.11.56, **54** (79), 171.—There have been 16 discoveries in Irion County, near the S. end of the E. shelf of the Permian basin in W. Texas since May 1955, and this has encouraged activity in the area. At least 7 pays have been found: Ellenburger, Strawn, Canyon, Wichita, Spraberry, Leonard (Clear Fork), and San Angelo.

Oil was first found in the area in 1928, but exploration was neglected until recent years. C. A. F.

302. Union Oil brings major Costa Rica field. Anon. *World Oil*, 1956, **143** (5), 298.—A well drilled in Costa Rica, approx ½ mile from the NE. border with Panama, in Limon Province, is reported to have flowed on test *ca* 1000 b.d. of 46° oil. Total depth was 4950 ft, and the well is the first commercial discovery in the country. C. A. F.

303. Remote Iranian wildcat reportedly major gusher. Anon. *World Oil*, 1956, **143** (5), 298.—A wildcat at Qum, *ca* 75 miles S. of Teheran, is reported to have flowed wild *ca* 80,000 b.d. It is 200 miles NE. of Lali, the nearest producing field, and is in a different geological province from the established Persian fields. C. A. F.

304. Yugoslavian wildcat discovers gas at 7800 ft. Anon. *World Oil*, 1956, **143** (5), 300.—A wildcat in NW. Yugoslavia *ca* 25 miles from the Lovaszi fields in Hungary has discovered natural gas at 7800 ft and reported production was 17 M.m.c.f/day. Gravity and seismic surveys have been carried out in the area, and further wells are planned. Other developments in Yugoslavia are briefly noted. C. A. F.

305. Pointer for the way to oil prospecting in Poland. Z. Olewicz. *Nafta* (*Krakow*), 1955, **11**, 153–7.—Recently discovered deposits of oil in N. Germany are in the formations

ranging from Oligocene to Permian. This oil is associated with salt deposits. Methods employed can be useful in Polish search for oil. In the Carpathians these formations are largely covered over due to tectonic movements, and search should confine itself to finding those places where they are accessible. In the N., geological structure needs more elementary investigations, but the oil-bearing formations here have not been disturbed. M. S.

306. Geological and radioactive surveys. N. Tichonravov. *Nafta* (*Krakow*), 1955, **11**, 217–19.—Mention is made of soil analysis, discovered by Sokolov in 1930, which was first applied in the U.S.S.R. in 1933; of bacterial analysis of soil, discovered by Mogilevsky; and of α- and neutron-logging. M. S.

DRILLING

307. Use of barium hydroxide in drilling muds. H. C. H. Darley and R. A. Generes. *J. Petrol. Tech.*, 1956, **8** (11), AIMME Tech. Paper No. 4409, 252–5.—Lime, when added to drilling muds to repress dispersion and hydration in drilling thick clay series, leads to the risk of solidification at high temp. Tests of the repressing effects of various reagents were made by centrifuging a 1 : 100 mixture of mud and N NaCl and noting the vol, while solidification tendencies were studied by heating for 16 hr at 150° and 370° F in pressure vessels, and then measuring the penetration by a standard cone. $Ba(OH)_2$ caused only a moderate increase in gel strength, even over periods of a month of heating. As a class hydroxides prevented dispersion better than salts. Hydroxides repressed dispersion at low ionic concn, whereas soluble salts had to be present in considerable ionic concn to give the same effect. Tannates and lignates were more effective with the hydroxides than with the salts in controlling the rheological properties of muds.

Tests showed the characteristics of barium and lime muds to be basically the same except for high temp behaviour, but $Ba(OH)_2$, because of its greater solubility, had the greater risk of high gel strengths due to over-treatment. Marked contamination with Ca ions makes a barium mud tend to solidify at high temp.

Field tests were made at depths of 10,943–12,629 ft, the mud control tests including clay vol, and alkalinity and Ba content of filtrates. In 3 trial wells costs were $2.75, $2.54, and $2.01/ft, compared with $2.95/ft for lime muds in the same area. The main difficulty with the Ba muds was getting the correct amounts to be added each tour. Commercial thinners other than NaOH are now available, and these facilitate control of gel strength and give greater repression of dispersion. G. D. H.

308. Diaphragm slush pump. M. E. True and W. M. O'Reilly. *J. Petrol. Tech.*, 1956, **8** (11), 11–13.—Reciprocating pumps for mud circulation have a short life and high operating cost because of abrasion by the material pumped. In the early 1940s plunger-actuated diaphragm slush pumps were being made for oilfield use. After several years' work a full-scale diaphragm slush pump has been built, and it has been used for drilling 70,000 ft of hole in the Gulf Coast in 2300 hr. The initial experiments used an aeroplane tail wheel tyre as a diaphragm, and a reciprocating pump deflated and inflated this with an emulsion of water with 2% soluble oil. A triplex single-acting plunger pump was then linked to a diaphragm unit on a well, and operated at 140–175 rev/min, giving 420–525 gal/min at 1400–1750 p.s.i. This unit operated quite well, but had some plunger packing troubles, and difficulties with the make-up and loss-control valves for the intermediary fluid. Standard slush pump pistons and liner assemblies were next used, with a water cooling system, and better valves for dealing with the intermediary fluid. Over 9 months this had only about half the cost of expendable parts that arises with conventional pumps.

The diaphragm assembly has been redesigned for fitting to commercial pumps, and one is in use with a 600-h.p. slush pump, having a centrifugal pre-charging pump to give pressurized suction. This required only *ca* 1 gal/hr of make-up fluid to cater for losses, and expenditure on expendable parts was only 58% of that for a conventional slush pump used under similar conditions. G. D. H.

309. From Soviet experience. A. Waliduda. *Nafta* (*Krakow*), 1955, **11**, 219.—More than double progress in directional drilling has been reported in May issue of *Nyeft. Khoz.* Very considerable saving was obtained, since 89·4% of the time was spent on actual drilling, and even so, potential drilling capacity of the bit could have been raised by approx ⅓. After 15 minutes of working under one ton pressure the latter was gradually raised to 15 tons. Strict control of mud was enforced. M. S.

310. Increase in effectiveness of a "serial" drill. R. A. Yoannesyan and N. J. Udyansky. *Nafta* (*Krakow*), 1955, **11**, 202–6.—The 3-bit tier-drill was introduced on an industrial scale in 1940. Statistical evidence shows that although m/drill have decreased between 1945 and 1952 from 41·5 to 37·2, the rocks which the new drill is capable of penetrating are much harder. Drilling was done to much greater depths, and the speed of drilling was more than doubled. At the same time turbo-drilling rose from 3 to 55% between 1940 and 1953. In other words, the new bits are capable of faster and more intensive drilling, but wear out in somewhat shorter time. The factory-produced 3-bit tier-drill is not as good as one made at the oilfield workshop. Great importance is attached to the right choice of steel, right way of sharpening, and hardening of the teeth. Details of the latter are given. Different bit manufacturing works adopt variety of slightly different methods, which allows the authors to compare their merits. M. S.

311. Science and technique in Soviet Union—towards improvement of drilling index in 1955. M. S. Timoffeyev. *Nafta* (*Krakow*), 1955, **11**, 163–6.—Between 1953 and 1954 the total simultaneous drilling hours fell by 12%. A further fall is planned for 1955, but during 1953–54 drilling progress in m/rig/month rose from 730 to 741 in productive drilling and from 224·9 to 231·1 in search for oil, and further rise is expected. This is due to better utilization of bits. Several new ideas were introduced in 1954. In Tartary and Baskiria 100 m/day were drilled on more than one occasion, even though nearly half the time was spent on lengthening the string of tools. However, the average for all drilling has shown a tendency to spend more time on raising and lowering the tool and less on drilling. That is due to forced drilling. In view of the effort to shorten the "non-productive" time in drilling, the years 1953–54 were disappointing: stoppages for logging were lengthy, due to the equipment often being in bad repair. Other stoppages occurred when new parts had to be supplied. For 1955 plans are made to provide adequate stocks. On the credit side new muds, cements, and prefabricated constructional units contributed to better results. Large financial investments were necessary in 1955. M. S.

PRODUCTION

312. Material balance above the bubble point. G. D. Hobson and I. Mrosovsky. *J. Petrol. Tech.*, 1956, **8** (11), 57–8.—For an oil accumulation above the bubble point

$$N = \frac{n(1 + \Delta p.C_o)(1 - S_w)}{\Delta p[C_o + C_f + S_w(C_w - C_o)]}$$

where N is the initial stock-tank oil in place, n the stock-tank oil produced, Δp the pressure drop, S_w interstitial water

saturation, and C_o, C_f, and C_w the oil, formation, and water compressibilities respectively, defined relative to the vol at the initial pressure. This relationship is slightly more complex than that obtained by Hawkins, who used an oil compressibility based on a standard at the lower pressure, and dropped a small term. G. D. H.

313. Measurements of fractional wettability of oilfield rocks by the nuclear magnetic relaxation method. R. J. S. Brown and I. Fatt. *J. Petrol. Tech.*, 1956, **8** (11), AIMME Tech. Paper No. 4386, 262–4.—Carefully sieved sand was treated with Dri-film to make it preferentially oil-wet, mixed with known proportions of untreated sand, and packed in tubes. After evacuation the sand was saturated with water. Relaxation times for nuclear magnetic polarization were then measured, and a linear relationship was found to hold between the relaxation rate and the percentage of Dri-filmed sand. On the basis of this conclusion it is proposed that the fractional wettability of reservoir rocks might be obtained. The core would be flushed with hexane or toluene until no more oil or water emerged, dried in vacuum, and saturated with dist water (this procedure is believed not to alter the natural wettability). After measuring the relaxation rate the core is rendered preferentially water-wet by firing at 950° F or treatment with chloroform and methanol. A relaxation rate measurement is made with the core water-saturated. Drying and treatment with Dri-film renders the core preferentially oil-wet for the third measurement when saturated with water. The 3 readings and the assumed relationship permit the fractional wettability to be determined. The theory of nuclear magnetic relaxation is briefly outlined, with some indication of the effects of surfaces in porous media. G. D. H.

314. New method of plugging breakthrough channels in oil sands. W. Dubis. *Nafta (Krakow)*, 1955, **11**, 157–8.—Breakthrough channels caused by excessive pressure used in secondary production (repressurizing) can be sealed by condensed steam. High-pressure subterranean gas burners have been constructed by the author following suggestion of A. Mikucki of the Polish IP workshops. Steam generated by the burner from water supplied from the surface condenses in the fissure, and so the seal is effected. A drawing and a list of components is included in the paper. M. S.

315. An approach to analysing ailing wells. R. Bethancourt. *Petrol. Engr*, 1956, **28** (10), B24.—Ways of determining whether remedial work on wells is required are described, and for this purpose wells are divided into 3 groups: producing oil wells, gas wells, and project wells (including injection wells).

Remedial work involves work-overs, repairs, recompletion, deepening, and conversion, which includes such jobs as water and gas shut-off, fracturing and allied treatments, casing and cement repair jobs, and limiting sand entry. Procedures and diagnoses for each of these are described with diagrams. A specimen well work recommendation form is included to show how it aids procedure and estimation of the time and costs involved in the job. C. A. F.

316. Unusual methods pay off—sometimes. T. J. McIntyre. *Petrol. Engr*, 1956, **28** (10), B129–34a.—4 examples of unorthodox techniques are described, while special mention is made that these will only bring success for workovers on specific wells. E. A. G. H.

317. Three-phase relative permeability. A. T. Corey, C. H. Rathjens, J. H. Henderson, and M. R. J. Wyllie. *J. Petrol. Tech.*, 1956, **8** (11), 63–5.—Gas and oil relative permeabilities have been measured on 9 Berea sandstone cores with $CaCl_2$ brine present as the wetting phase in saturations ranging 17–71%. The results are given as ternary diagrams showing oil, water, and gas isoperms. Some calculated oil isoperms are also given.

The derivation is given of a relationship for K_{ro} in terms of saturations for a 3-phase system, assuming that the gas–oil capillary pressure curve for a 3-phase system can be approximated by $\frac{1}{P_g^2} = \begin{cases} C(S_L - S_{Lr}) \text{ for } S_L > S_{Lr} \\ O \text{ for } S_L \leqslant S_{Lr} \end{cases}$

The theoretical and experimental studies suggest that it is feasible to calculate both oil and gas relative permeabilities from measured gas relative permeabilities, if the water permeability of a 3-phase system is a function of its saturation only, and the same as for 2 phases, and that the residual oil saturation resulting from desaturation with water $\geqslant S_{Lr}$ will be zero. G. D. H.

318. Adaptation of friction factors to the flow of fluids through consolidated formations. L. F. Stutzman and G. Thodos. *J. Petrol. Tech.*, 1956, **8** (11), 59–62.—Cornell and Katz have plotted a friction factor, f, against a modified Reynolds No., (Re) mod, for linear flow of fluids through consolidated porous media.

$$f = \frac{9216 g_c \rho (P_1 - P_2) A^2}{\beta L W^2} \text{ and (Re) mod} = \frac{\beta W K}{6{\cdot}32 \times 10^{10} A \mu}$$

A = area perpendicular to flow (ft²) $g_c = 32$; K = permeability (mD); L = distance (ft); P = pressure (p.s.i.a.); β = turbulence coeff (ft^{-1}). This plot is used directly and no use is made of equations for laminar or turbulent flow. To solve a problem of linear flow the modified Reynolds No. is first obtained, and thence the friction factor. For radial flow the plot cannot be used directly. The friction factor can be presented in differential form, and integration is possible if average values of ρ and μ are usable. For laminar and turbulent flow analytical integration can be made, but this is not practicable for the transition region, and hence graphical integration is used.

Examples are given of the use of the techniques for linear and radial flow. G. D. H.

319. More oil from water-flooding? H. G. Botset. *World Oil*, 1956, **143** (4), 176.—Field experiments in the Bradford field, Pennsylvania, which have recently been made in order to test new techniques in water-flooding, are described briefly. These techniques include the heating of injection wells, the use of wetting agents, and the use of CO_2 in soln in injection water. The effect of gas injection in water-flooding is also discussed. Results of the tests are shown in a series of curves.

The evaluation of any technique in field application is very difficult because of the non-homogeneity of reservoirs.

C. A. F.

320. Prediction of oil recovery by water flood—a simplified treatment of the Dykastra–Parsons method. C. E. Johnson. *J. Petrol. Tech.*, 1956, **8** (11), 55–6.—The semi-empirical Dykastra–Parsons method is applicable to formations with initial oil saturations of 45% or more, and makes use of correlations of vertical permeability variation, V; mobility ratio, α; initial water saturation, S_w; and fractional recovery of oil in place at a given producing water–oil ratio, R. The correlation between V, α, S_w, and R, for a given producing water–oil ratio, can be shown on a single graph, and this can be done by plotting V against α for lines of constant R $(1 - S_w \cdot WOR^{-0{\cdot}2})$, separate graphs being used for water–oil ratios (WOR) of 1, 5, 25, and 100. V and S_w can be obtained from core analyses; $\alpha = \frac{k_{rw}}{k_{ro}} \cdot \frac{\mu_o}{\mu_w}$. k_{rw} and k_{ro} can be measured or estimated from Leverett and Lewis' data for loose sands. Knowing the producing water–oil ratio and V and α the factor $R(1 - S_w \cdot WOR^{-0{\cdot}2})$ is obtained, and with S_w known for the beginning of the flood, R can be calculated. G. D. H.

321. How do you solve your water-flood problems? A. Gibbon. *World Oil*, 1956, **143** (5), 264.—The results of a dis-

cussion held to consider water flooding problems in the Mid-Continent area of the U.S.A. are summarized.

Items discussed include the use of fracture treatment as a preliminary to water injection, fracturing impermeable rocks, fracturing old wells, the use of pilot floods, and economic factors. C. A. F.

322. Safe practices in workover operations. D. A. Klemme. *Petrol. Engr*, 1956, **28** (10), B134b–6.—Safety precautions for workovers are discussed in the light of the fact that one accident can more than offset the rewards anticipated. E. A. G. H.

323. Multiple zone workovers. R. W. Reiss. *Petrol. Engr*, 1956, **28** (10), B156–7.—The utility of multiple completions as regards future workovers is discussed. Such completions suffer from obviously increased chances of mechanical trouble, while they may minimize development well cost through minimizing subsequent workovers. E. A. G. H.

324. Heat treatment of old oil reservoir. E. B. Chekaluk *et al.* *Nafta* (*Krakow*), 1955, **11**, 207–14.—The work done by the U.S.S.R. Academy of Sciences in 1934–49 was without industrial effects. This article gives the mathematical theory of the operation. Under 4 headings the authors consider: (1) how heat spreads from the point of its introduction; (2) losses from the formation; (3) losses at the point of introduction; (4) practical calculation of heat balance. (1) $dQ_{\text{rock}} = 2\pi r(\text{spec heat of rock/cu. m.}) \times \Delta T \times dr$ and $dQ_{\text{of heating medium}} = \text{Volume velocity} \times (\text{spec heat of medium/cu. m.})\Delta T dt$, ignoring any losses. Then $\Delta T = f\left(t - \frac{\pi \times \text{porosity} \times \text{Sp. ht.}_{\text{rock}}}{\text{Vol. velocity} \times \text{Sp. ht.}_{\text{med.}}} (r^2 - r_o^2)\right)$. When the hot medium penetrates the rock it has the same effect as if a hot wave moved radially from the centre, and it is possible to pump in cold medium in its wake. Analysing the effects of various media, the authors find water at 200° C and 16 atm the best. It will get all residual crude from sandstone. (2) Losses from roof and base of formation,

$$Q_{\text{loss}} = \tfrac{2}{3}\pi\sqrt{\frac{\text{Porosity of rock} \times \text{Sp. ht. of med.}}{\text{Visc. of medium} \times \text{Vol. vel. med.}}} \times \Delta T \times r^2 \quad \text{(approx)}$$

if r denotes the extent of hot " pancake "-shaped formation; if cold water follows hot, losses are limited, since only the hot section of the " pancake " loses heat. (3) Losses at the borehole are generally as large as those mentioned in (2), but can be considerably cut by using pipes of low conductivity. (4) Takes into account the variation in porosities and conductivities encountered in actual cases, as well as tectonic interferences wherever they occur. Practical difficulties and advantages are described. M. S.

325. Reservoir mechanism of sulphur recovery. J. R. Rayne, B. C. Craft, and M. F. Hawkins. *J. Petrol. Tech.*, 1956, **8** (11), AIMME Tech. Paper No. 4385, 246–51.—At present 40% of the world output and 80% of the U.S. output of sulphur is obtained by the Frasch process. Sulphur occurs in pores, cavities, and fractures in salt-dome cap-rocks, which are most heterogeneous in properties. Porosity averages *ca* 20% and sulphur saturation 25% by wt. Net sulphur producing rock may be a few to several hundred ft thick, with much barren rock above. In drilling, the cap-rock section is underreamed to 9¾ inch. Casing with a closed bottom rests in the hole and has 20 ft of perforations opposite the lower part of the sulphur-bearing rock. A seat ring supports the sulphur pipe 5 ft from the bottom of the perforations, and hot water is injected through the annulus between the casing and the sulphur pipe; it leaves the upper perforations, while molten sulphur enters the lower ones and is lifted to the surface by compressed air. Water bleed wells are drilled to remove excess mining water at points 500–3000 ft from producing wells. At Grand Ecaille the original well spacing was 125 ft, and infills reduced this to *ca* 50 ft. Sulphur recovery may be 75%, good wells giving 15–20 tons/hr, with water injection 1000–20,000 gal/ton. Hot water caps may extend over wide areas. The underground thermal efficiency may be *ca* 5%. Subsidence damage is one of the primary causes of well abandonment. Corrosion is also a severe problem. The near-vertical rise of the hot water tends to limit the gravitational drainage area.

Model studies (one- and two-well) have been made using *para*-dichlorobenzene in pea gravel to represent sulphur. Water was injected at 160° F, and at 0·75 and 1·25 gal/min in both systems, and at 0·25 gal/min for the one-well system. The two-well system was better both in rate and in cumulative recovery. The melting pattern resembled an inverted cone, and there was subsidence. G. D. H.

326. Extended analysis of bottom water drive reservoir performance. T. S. Hutchinson and C. E. Kemp. *J. Petrol. Tech.*, 1956, **8** (11), AIMME Tech. Paper No. 4387, 256–61.—Muskat's analysis of bottom water drive reservoirs has been extended by approx methods to include gravity effects and non-unity mobility ratios. The results of the computations are presented, along with various conclusions. Volumetric sweep-out efficiency will ordinarily be less than 10%, but at high water–oil ratios the swept volume may become as much as 90%. Abandonment of volumetric efficiency increases with decreased well spacing, and decreased well penetration, and with increasing gravity effects, oil zone thickness, and horizontal to vertical permeability ratio. The decline of productivity index with volume swept is essentially independent of mobility ratio after water break-through. Well stimulation by decreasing draw-down will aid the effectiveness of gravity factors; fractures at the top of the oil zone or a widespread permeability shield just below the perforated interval would also help in improving recovery. In principle, volumetric efficiency can be improved by rate reduction, but there are practical limits, for a ten-fold rate reduction would be needed for 13% increase in sweep-out at a water–oil ratio of 15. G. D. H.

OILFIELD DEVELOPMENT

327. Williston basin exploration needs boost. K. Trout. *Oil Gas J.*, 5.11.56, **54** (79), 173.—Factors affecting the economics of exploration in the Williston basin of N. Dakota are discussed: these include the cost of drilling for and producing oil and gas, success ratios, marketing conditions, quality and types of drilling, and conditions of pay-out and investment return. It is concluded that the area is being neglected and that further exploration and development are economically sound. C. A. F.

328. E.N.I. oil in Italy. The A.G.I.P. story. A. Jacoboni. *Oil Forum*, 1956, **10** (10), 350–3.—Pt. III. If a bill—passed by the Italian Chamber of Deputies—be approved by the Senate, private oil companies will be at a still greater disadvantage compared with government-controlled E.N.I. Private firms are operating in the Po valley on equal terms with E.N.I. subsidiaries. E.N.I. permits in Italy = 14,863,167 acres, private = 5,851,809 acres; E.N.I. concessions = 12,355,689 acres, private = 233,820 acres. In view of the bill—and not to interrupt work of permit and concession holders in areas covered by the law—a max production is allowed on an experimental basis. Petroleum deposits capable of development have been found both by E.N.I. and private companies. Prospects in Central and S. Italy and Sicily are favourable. E.N.I.—in addition to extensive exploration and development work in the Po valley—is active in S. Italy and Sicily. E.N.I.'s activity related to its limited extension permits exceeds that of combined private companies. R. T.

TRANSPORT AND STORAGE

329. "Fluid floating roof" lives up to promises. W. A. Keutgen. *Oil Gas J.*, 26.11.56, **54** (82), 91.—4 companies have reported on use of a "Microballoon" sealing foam in cone-roof working tanks and state that significant reductions in crude oil evaporation loss have followed its use. G. A. C.

330. Bridgwater installation. Anon. *Fluid Handl.*, 1956, 334–8.—Description, with illustrations and sketch maps, of the new Shell-Mex and BP distribution depot nr Bridgwater, serving Devon and Dorset. Supplies are received by coastal tanker at a jetty and piped ¼ mile to the installation, which comprises tank farm, road wagon filling gantry, pump platform, service building, stores, and admin building. W. A. M.

331. Unique tools and methods used in gas well workovers. S. S. Galpin and P. H. Montgomery. *Petrol. Engr*, 1956, **28** (10), B140–53.—Problems associated with reactivating depleted gas fields for underground storage are given. Among the improvised tools described are the "down-the-hole camera," cement bomb, pipe basket, and the magnesium guide pipe. Other techniques include lowering casing into crooked holes and air pressure and purging tests. E. A. G. H.

332. Coating and wrapping of pipelines. J. W. Jones. *Fluid Handl.*, 1956, 311–15, 347–9.—Increased speed of welded pipeline construction has necessitated mechanization of coating and wrapping as protection against corrosion. Illustrated descriptions of coating and wrapping machines and technique are given. Before the coat of protective enamel is applied, the pipe must be cleaned and primed, and these operations are carried out by a similar type of machine. Some account is also given of ancillary operations, *e.g.* cradling of pipe, preparation of enamel, use of heating kettle, and correct storage of wrapping felt. The quality of the coat and wrap is tested by applying a high voltage from a portable generator to a rolling spring electrode; weak spots cause a discharge which gives audible warning; patching is done manually. Stress is laid on the need for co-ordination of the various operations in the field to achieve max efficiency. Tables are given (p. 349) of the wt of enamel and No. of standard rolls of felt required for 1000 ft and 1 mile lengths of pipelines of dia up to 36 inches. W. A. M.

333. The modern approach to communication and transmission systems. V. J. Nexon. *Pipe Line News*, 1956, **28** (9), 36–44.—A comprehensive survey of modern pipeline communications and telemetering systems. D. B. S.

334. Pump efficiencies determined from fluid temperature rise. G. P. Jennings and L. P. Meade. *Pipe Line News*, 1956, **28** (8), 35–7.—This method for determining pump efficiency is based on the assumption that all the losses are converted to heat, which in turn raises the temp of the liquor being pumped. An expression is developed for incompressible fluids; this may be used for compressible fluids if corrections are made for the rise in temp due to the compression in the pump. It was found that for 8 hydrocarbon mixtures of varying sp. gr. the temp rise when the pressure was suddenly increased by 1000 p.s.i. was a straight line function when plotted against the sp. gr. Therefore, knowing the sp. gr. of the fluid, the differential pressure in the pump, and the actual temp rise through the pump, the net rise and hence the pump efficiency may be obtained. In some cases, where the fluid is very compressible, the sp. gr. must be corrected also. D. B. S.

335. Crude measurement devices—their development and application. M. H. Atkinson and A. H. Newberg. *Pipe Line News*, 1956, **28** (8), 27.—In this review the use of sampling devices for the automatic determination of gravity, viscosity, vapour pressure, colour, fl. pt., etc., receives particular attention. D. B. S.

336. Hydraulics for pipeliners. Pts XIX, XX. C. B. Lester. *Pipe Line News*, 1956, **28** (6), 28–31; **28** (7), 20–4.—Functions and characteristics of various types of control valves when used for pipeline duties are fully discussed. D. B. S.

337. Remote control of sea line pumps. Anon. *Fluid Handl.*, 1956, 305–6.—Tankers at Lutong, Sarawak, are loaded from offshore berths, with a consequent problem of ship-to-shore communication. This has been solved by installation of radio telephone and control equipment, comprising a shore transmitter–receiver and mobile transmitter–receivers for use at the 4 berths. The installation incorporates a system whereby, if a pumping emergency arises on board ship, pushing a button sends out a call which is received at the pumping station as a specific audio-frequency; this actuates a relay which cuts off the fuel supply to the pumps loading the ship concerned. Audible and visible warnings of the shut-down are also given. W. A. M.

338. Pipeline flow calculations. J. W. J. Barcher. *Petrol. Engr*, 1956, **28** (10), D33–8.—The author includes data for gas pipeline flow calculations. In this instance, the effects of elevation upon pressures in a gas pipeline may, in hilly terrain, require observed pressures to be corrected before accepted flow formulæ may be applied. E. A. G. H.

339. Long pipeline wrapped with plastic tape. P. Reed. *Oil Gas J.*, 20.11.56, **54** (82), 70.—American Louisiana Pipeline Co has had its 22-inch line from Defiance, Ohio, to Bridgman, Michigan, a distance of 122 miles, wrapped with a plastic type of polyethylene from end to end, at a cost of 45 cents/lineal ft. G. A. C.

340. Gas-compressor station goes automatic. R. Lochiano. *Oil Gas J.*, 5.11.56, **54** (79), 94.—Selection of equipment and outline of problems given for Stanton, Kentucky, remote-controlled station of Gulf Interstate Gas Co. G. A. C.

341. Natural gas transport economics in the U.S.A. J. Devaux-Charbonnel. *Bull. Ass. franç. Tech. Pétrole*, 1956, 519–34.—U.S. reserves at end of 1955 were $22{\cdot}3 \times 10^{13}$ ft³, 1955 production was 10^{13} ft³, gas line system extended to 419,000 miles. Production from *ca* 8000 producers is distributed by approx 100 carriers. Nature of contracts between producers and carriers, and carriers and distributors–users are discussed and price structure described. Role of Federal Power Commission in this sphere is outlined. Map of U.S. gas lines. V. B.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

342. Refining—a story of progress. C. F. Smith. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 13–15.—The exceptional growth of the petroleum refining industry has resulted from the industry's readiness to meet new challenges, its continual search for new markets and more efficient methods, and the technical competence of its personnel. Problems of unbalanced supply and demand have been met by improved operating flexibility, new equipment and processes, and reasonable reserve capacities. In the future, petroleum products will be increasingly tailored for specific uses. The chemical and petroleum industries may be expected to merge until they become almost indistinguishable. Crude oil requirements will become less critical, so that synthetic crude oils from shale, tar sands, or coal may be used. Hydrogenation processes and synthetic lubricants will become increasingly important. (Author's abstract.)

343. Economic problems of modern petroleum refining in U.S.S.R. K. Szadkowski. *Nafta (Krakow)*, 1955, **11**, 214–16.—More thorough refining of crude oil would make products more expensive. Compared with the 19th century, the main purpose shifted from max yield of paraffin oil (kerosine) to petrol (gasoline), which with development of aviation had to be more refined chemically. Cracking led way to petrochemicals, starting with pure hydrocarbons and synthetic rubber. More recently requirements of diesel fuel have increased. In spite of larger and more varied demands for petroleum products, 47% of crude still forms useless residues, which are burned. 55 years ago the figure was 62%. It is this residue that must be de-asphalted and cracked in the future. Hydrogenation is not the rational answer, since it yields aromatics. It is also very expensive. New methods are necessary. The only way of making the existing processes economical is the utilization of by-products and special products. Only in this way can 80% utilization of crude be achieved. Choice of crude must depend on the use to which it is going to be put, and correct balance of refining processes must be applied with the aim of complete utilization. M. S.

344. A look at hydraulic rich-oil motors. B. J. Thompson. *Oil Gas J.*, 19.11.56, **54** (81), 245.—Feasibility of using rich-oil powered drivers for continuous service is discussed, and their application to various oil operations is described. G. A. C.

345. Chart that job. L. Reden. *Oil Gas J.*, 5.11.56, **54** (79), 120.—Standard Oil Co employs a multi-column flow process chart at its Baton Rouge plant to outline all the steps relating to a particular job, with the view to eliminating all unnecessary work.

A flow process chart illustrates the article. G. A. C.

346. Air flotation used to separate oil at Richfield's non-waste-water plant. D. H. Stormont. *Oil Gas J.*, 26.11.56, **54** (82), 80.—The plant at Los Angeles refinery of Richfield Oil Corpn uses floating-roof tanks for pre-skimming, and dissolved air flotation cells for removing most of remaining oil from waste water. G. A. C.

347. How to plan a microwave radio relay system. D. R. Marsh. *Oil Gas J.*, 26.11.56, **54** (82), 82.—This is the first of a 2-part article and describes how to select suitable sites, determine antenna heights and propagational reliability, and select towers, building, and power accessories. Diagrams illustrate siting requirements. G. A. C.

348. Chart gives liquid gradient on plates. F. Rodriguez. *Chem. Engng*, 1956, **63** (11), 230.—A nomograph has been constructed to give a direct solution for the liq gradient across the plates of a bubble cap column from a knowledge of the column dimensions and liq flow rate. This replaces the former trial and error method of solution. D. H. A.

349. Update your reactor design method. J. C. Chu. *Chem. Engng*, 1956, **63** (11), 215–20.—The important points to be considered in the design of a reactor are its size, the means of supplying or removing heat, control and instrumentation, and suitable materials of construction. The design equations are given for a flow reactor. They are the material and energy balances, the kinetic equation, and the heat transfer and pressure drop relationships. The design of agitated reactors and the effect of an additional reactant stream are discussed. D. H. A.

350. Pick the right pump for the job. J. A. Cable. *Petrol. Process.*, 1956, **11** (10), 69.—The work any centrifugal pump can do is best shown by a performance curve. By cross plotting pump curves against system curves (depending upon friction and static head), it is possible at a glance to see if a pump will fit the conditions. J. H.

351. Industry's first circular boiler completes six successful months. N. E. Pennels. *Petrol. Process.*, 1956, **11** (10), 82–6.—A new approach in boiler furnace design, aimed at more efficient use of fuels in the refinery, has now completed over 6 months of successful operation at the East Chicago, Indiana, refinery of Sinclair Refining Co. The unit, a carbon monoxide burning boiler with a unique new circular design, operates in conjunction with an existing 40,000-b.d. fluid cat cracking unit. It burns the CO in the fluid unit regenerator flue gas and uses aux fuel as needed. The boiler is designed to produce 275,000 lb/hr of 565 p.s.i.g., 750° F steam. The boiler has many advantages over the normal rectangular type, such as saving of considerable ground space, elimination of a water seal between the primary and secondary furnaces, and the use of a smaller amount of steel to pressurize a circular boiler—a conventional box-type boiler requires large structural beams. A circular boiler also provides better heat distribution and improves boiler water circulation, due to the elimination of corners that cut down water circulation and invite internal sludge deposits. J. H.

352. Taming wild waste water. Pt 2. G. W. Brown and J. E. Sublett. *Petrol. Engr*, 1956, **28** (10), C3–7.—A modified unit to increase the efficiency of waste water processing from a Union Oil Co refinery is described. The primary separator is completely covered to reduce air pollution from hydrocarbon evaporation and the pH of entering effluent controlled between 6·5 and 7·5. All recovered oil and emulsions are separated by gravity, the middle emulsified layer being pumped through a demulsification unit to the final separating tank. E. A. G. H.

353. Purification of waste waters containing cresol. W. Windisz. *Nafta (Krakow)*, 1955, **11**, 160–2.—New refining processes create their own waste disposal problems. Existing equipment will not remove homologues of phenol. These are present in quantities of 0·1–0·2% in the bottoms from cresol recovery plant following solvent refining. Quantity of such effluent depends on the scale of the operation, and final percentage of cresol in waste may be very low indeed. Even so,

it is deadly to fish. Several methods of purification of waste are known, but none reaches the lower limit of less than 0·1%. Only a closed circuit will keep the losses down and prevent contamination of drinking water. M. S.

354. The development of coolers and condensers in the oil industry. S. J. H. Breukel. *Ingenieur, 's Grav.*, 21.9.56, **68** (38), Ch 49–56.—25 years ago, the corrosion to which ordinary steel tubes in gasoline condensers were subject led to an investigation to find a better material for these condensers. As this material was more expensive, it was only justifiable to use these better tubes by constructing more effective condensers, *i.e.* with a much higher H.T.C. This led to the standard vertical condensers, which 5 years ago were improved somewhat. After a summary of different standard sizes, several advantages of this vertical design are mentioned.

In the last paragraph a review of the horizontal condensers and coolers is given. 8 figs. (Author's abstract.)

355. Graphitization of steel in petroleum refining equipment. J. G. Wilson. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 209–48.—This report presents the results of tests conducted on 554 samples of carbon and carbon–molybdenum steel removed from petroleum refining equipment and examined for evidence of graphitization. Graphite formations were found in 33·8% of these specimens.

It has been established that some steels have a greater tendency to graphitize than others; and that high aluminium content (in excess of 0·015%), high operating temp, and the steel-making process used in meeting certain specifications are factors which affect graphitization. Of the steels examined, ASTM A106 pipe indicated the highest tendency to graphitize, and of the carbon steels, ASTM A285 plate material indicated the highest resistance to graphitization. Connected nodules of graphite were found in both carbon and carbon–molybdenum steels. Although the carbon–molybdenum steel graphitized less frequently than the carbon steel, when it did graphitize, graphitization was of the more serious type.

At a temp of 1025° F accelerated lab tests were made at successive 1000-hr periods to predict the graphitization of steel under service conditions. These tests showed that a steel which does not graphitize in service is not necessarily immune to graphitization. The tests also indicate that certain "heats" of plain-carbon steel, with a high aluminium content, resisted graphitization throughout 50,000 hr of service life, as well as after 3000-hr accelerated test periods at a temp of 1025° F. It is not understood why some steels exhibit so little tendency to graphitize.

Furthermore, the data developed to date do not reveal any condition which would indicate that the sampled pressure equipment is unsafe for further service.

The series of stress-rupture tests now being conducted on graphitized plate may provide a more exact evaluation of the effect of graphitization on the high-temp properties of welded steel. (Author's abstract.)

356. Mechanical properties and weldability of six high-strength steels applicable to pressure vessels. R. D. Stout and J. H. Gross. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 249–57.—The Pressure Vessel Research Committee selected 6 high-strength steels representing 3 strength levels for extensive mechanical tests in order to determine their suitability for use in pressure vessels with increased design stresses. This paper reviews the results of investigations at Lehigh University, Chicago Bridge and Iron Co, University of Illinois, and Ecole Polytechnique. These 6 steels have been compared on the basis of room- and elevated-temp tension tests, notch-toughness unwelded and welded, plastic fatigue, and standard weld qualification tests. In general, the properties of these steels compare favourably with those of carbon steels. (Authors' abstract.)

ABSORPTION AND ADSORPTION

357. Enrichment of aromatics in gasoline fractions by silica gel adsorption. G. Lo Giudice and E. d'Acquarone. *Riv. Combust.*, 1956, **10** (10), 717–32.—Experiments have been carried out, in a pilot unit, on the enrichment of aromatics in gasoline fractions by silica gel adsorption. The regenerability of the adsorbent, and its adsorbing power, have also been studied. The results obtained have shown the efficiency of the procedure for the concn of the aromatics, and have evidenced some unfavourable operating factors which must be taken into account for a possible development of the method on a commercial scale. (Authors' summary.)

358. Operational difficulties in natural gasoline adsorption plant. W. Gunia. *Nafta (Krakow)*, 1955, **11**, 168–9.—Most Polish plants were built between 1920 and 1930. They are not efficient or suitable for low pressure gas containing a fair proportion of air. Due to high loading of carbon, methane to butane fraction is mostly lost. If these gases were trapped, precious bottled gas could be produced. There is a shortage of activated carbon, and its regeneration is inadequate. Difficulties with cooling, especially in summer, are considerable. M. S.

CRACKING

359. Feed preparation a problem? Anon. *Petrol. Process.*, 1956, **11** (10), 55–7.—A unique new feed preparation process for cat cracking charge stock is being advanced as an economic approach to the problem of increasing gasoline yield from crude. It is essentially a treatment of the crude oil with a boron trifluoride ethyl–ether complex, which separates and removes as much of the coke-forming and metallic constituents as possible while minimizing loss of useful heavy ends. The process, developed and patented by the Chinese Government Procurement and Services Mission, a division of Chinese Petroleum Corpn, New York, is not in commercial operation, but it is expected that with a typical example of 31·8° API Kuwait crude oil mixed with 2·5 vol% of the BF_3-ether and centrifuged, the treated crude when fractionated and further cat cracked with natural cat could produce a 20% increase in dollar returns. The process can also be used in treating heavy recycle oil, No. 2 fuel oil, and cat reformer feed. J. H.

360. Single-case reforming teams up with Unifining. R. Ladee. *Oil Gas J.*, 5.11.56, **54** (79), 111.—The fluid desulphurizer unit at the Billings, Montana, plant of Continental Oil Co has been converted to Unifining to obtain better sulphur removal in the diesel fraction, and to obtain the necessary hydrogen. The cat reforming unit is being used for its generation. G. A. C.

361. New Cosden unit makes 104 octane. Anon. *Oil Gas J.*, 19.11.56, **54** (81), 238.—The 3870-b.d. U.O.P. reforming unit at Big Spring, Texas, is described. Feed is predominantly W. Texas straight-run naphtha and a depentanized natural gasoline, and it is predicted that 79% liq vol fuel of 104 octane will be produced. Process flow diagrams of the Reforming and fractionation units are given. G. A. C.

SPECIAL PROCESSES

362. Petroleum chemicals at Grangemouth. Anon. *Petrol. Times*, 23.11.56, **60** (1547), 1054.—The styrene monomer plant of Forth Chemicals Ltd, Grangemouth, opened Nov 1956, is described. An alkylation process is used to manufacture styrene monomer, basic materials being benzene and ethylene. G. A. C.

METERING AND CONTROL

363. Petrochemicals look for new instruments. R. G. Marvin, W. L. Stuart, G. W. Lunsford, and E. E. Ludwig. *Petrol. Engr*, 1956, **28** (10), C46–8.—The authors mention the awakening interest of industry in automatic computers and divide the application of analogue and digital types into various problems. The measurement and control of pressure in gas streams has been a source of difficulty. The uses of the strain cell for pressure control and the impeller-type flow-sensing cell for measurement are illustrated diagrammatically.
E. A. G. H.

PRODUCTS

CHEMISTRY AND PHYSICS

364. Chemical and electrical stability of oils. S. E. Krein *et al. Khim. i. Tekh. Topliva*, 1956, (2), 60–8.—Effects of oxidn (120° C, 300 hr), with and without cat (Pb, Cu, Fe), static, in air) followed by chemical (acid val) and electrical (tan δ) tests on various lub oils and on naphthene–paraffin (N–P) and aromatic (A) fractions separated therefrom by adsorption. Found that chemical and electrical stability differ, thus N–P are more susceptible to oxidn, but the electrical properties of the oxidized fractions do not show very marked deterioration, whereas A, whilst more resistant chemically to oxidn, deteriorate very sharply as regards elec tests. Effect of oxidn products in causing deterioration in elec properties increases with decreasing mol. wt. of the oils. Fractions differ in response (as shown by elec tests) to cat, lub oils most susceptible to Cu, whilst N–P therefrom are most susceptible to Pb. For metal-catalysed oxidn the acid val is not a reliable guide to extent of chem deterioration, since acidic products react with the metals to form soaps; such soaps also markedly worsen the elec properties. V. B.

365. The electric strength of hydrocarbon gases. A. E. D. Heylen and T. J. Lewis. *Brit. J. appl. Phys.*, 1956, **7** (11), 411–15.—Measurements are reported of the static electric strengths of pure hydrocarbon gases over a range of pressures and spark-gap spacings. The values are related to mol structure in a way which is more complex when unsaturated cpds are also considered. Possible correlations with spectroscopic and other structural factors are discussed. Pulse discharges which occur readily in these gases at fields below the breakdown value are attributed to the exceedingly small secondary ionization coeff. C. N. T.

ANALYSIS AND TESTING

366. Needed—a new knock yardstick? C. J. Domke, N. D. Esau, D. S. Gray, and H. R. Taliaferro. *Petrol. Engr*, 1956, **28** (10), C38–40.—Research work by the Esso Co on research and motor O.N. is described. The engines used were an experimental V-8 and production V-8, while test fuels were made in 3 groups: olefinic blends of di-*iso*butylene in primary reference fuel, aromatic blends of benzene or toluene in primary reference fuel, and commercial-type gasolines. Experimental technique did not resort to abnormal ignition timing. E. A. G. H.

GAS

367. Analysis of natural gases; methods and applications. J. P. Verrien. *Rev. Inst. franç. Pétrole*, 1956, **11** (5), 641–83.—The effects of temp and pressure on the equilibrium in natural gases is discussed, and reference is made to the problems of sampling such gases and to the storage and transference of the samples. The various methods available for analysing natural gases are outlined, mention being made of vapour phase chromatography, mass spectrometry, the use of differences in vapour tension, and of the examination of the non-hydrocarbon content of the gases.

From the composition the density, calorific value, explosive limits, and various thermodynamic properties can be calculated. It is also possible to predict the behaviour of the gas in the course of production as the pressure and temp change. For purposes of illustration the gas from Saint-Marcet is discussed, reference being made to composition changes during production, recovery of natural gasoline, calculation and measurement of the compressibility, metering, and the calculation of the fugacity. G. D. H.

368. The utilization of natural gas in the evolution of the town gas industry. I. Giordano. *Riv. Combust.*, 1956, **10** (10), 691–716.—A quick survey is made of the evolution of the town gas industry, with the particular aim of focusing the transformation with time of the concept assumed as a basis for identification and index apt to characterize the behaviour and interchangeability of gaseous mixtures, which has today a concrete expression in the Delbourg Index. A survey is therefore made of new sources of raw materials and new techniques of gas production, in view of the progressive conversion to methane distribution, pointing out the conditions which differentiate their application in Italy and Europe generally compared with other countries rich in mineral oils.

As regards conversion to methane in large cities, even where it is integrally applied, the author, on the basis of the reasons brought forward, expresses his personal opinion on the convenience of an orientation towards a distribution of gas with medium calorific value if allowed by different necessities and conditions. On the other hand, in medium and small towns his opinion is that such a rule should not have a decisive character.

The author emphasizes the condition in a methanized distribution when anticipating the possibility of a partial or total substitution of mineral gas with other gases interchangeable with it, but having calorific values considerably different, and therefore the necessity of establishing a new rate system which takes this unavoidable necessity into account.
(Author's summary.)

ENGINE FUELS

369. Chemistry of inhibitor sweetening. R. H. Rosenwald. *Petrol. Process.*, 1956, **11** (10), 91–5.—One method of sweetening sour gasoline is by inhibitor sweetening. This involves storing the caustic scrubbed fuel for short periods of time in the presence of air and a substituted phenylene diamine type inhibitor, such as U.O.P.'s No. 5 inhibitor. The end result is an air oxidn of the mercaptans in a cracked gasoline, using the inhibitor as a cat. The process offers a simple and economic method of removing the undesirable mercaptans from motor and aviation fuel. J. H.

370. Effect of sensitivity on road octane number. W. E. Morris. *Oil Gas J.*, 26.11.56, **54** (82), 93.—Gasolines with a low sensitivity are superior in road performance to gasolines with a high sensitivity of same research O.N. G. A. C.

371. Petroleum products—nature and properties. V. A. Kalichevsky. *Petrol. Engr*, 1956, **28** (10), C20–23.—This article deals chiefly with liq fuels other than gasoline, namely kerosines, diesel fuels, jet fuels, dist fuel oils, and residual fuel

oils. Their physical and chemical properties are discussed in relation to usages. Solvents are also mentioned, being divided into 2 general groups, mixtures of saturated hydrocarbons and those rich in aromatic hydrocarbons of high solvent power. E. A. G. H.

LUBRICANTS

372. Urea-adduct process gains ground in lubricating oil dewaxing. Anon. *Chem. Engng*, 1956, **63** (11), 114–16.—Standard Oil's new $2 million plant, which is the world's third and the largest one of its type, will produce more than 10 million gal/year of low pour-point (− 70° F) lub oils by selectively locking wax-forming paraffins into filterable urea-complex crystals. The process operates at room temp and avoids the use of refrigeration. Its general principles are described. The problems that arise in the process and various ways of overcoming them are discussed. D. H. A.

BITUMEN, ASPHALT, AND TAR

373. Plant control of bituminous concrete mixes. D. D. Dagler. *Rds & Str.*, 1956, **99** (11), 126.—Asphalt tanks, stockpiles and their segregation, automatic feeds, plant screens, mixers, pyrometers, and plant-testing laboratories are considered in control of mixes. G. A. C.

SPECIAL HYDROCARBON PRODUCTS

374. Gas evolution in condenser oil. V. T. Renne and Tsyui Si-Sin. *Zhur. Tekh. Fiz.*, 1956, **26**, 1070–9.—Tests made with paper–Al condenser (capacity 10^4 pF) impregnated (at few mm Hg) with 180 ml oil; tests at atm pressure, room temp, 50 cycles; sketch of condenser and circuit diagram. Oils used were a white oil and standard transformer and condenser oils, properties measured were gas evolution and p.f., both of which were improved by addition of aromatics (5–15% of benzene or naphthalene). Increase of test temp to 50° C did not affect the overall picture, increase of vac used for condenser impregnation decreased p.f. V. B.

375. Examination of the causes of increased dielectric losses in commercial transformer oils. Ch. M. Dzhuvarly and L. A. Mukharskaya. *Khim. i Tekh. Topliva*, 1956, (5), 59–63.—In view of high dielectric loss shown by large proportion of (acid-treated) transformer oils delivered to industry, tests (tan δ and resistivity at 10 kV/cm, industrial frequency, 20° and 70° C) were made on numerous such oils. Close agreement between d.c. and a.c. resistivity indicates absence of dipole losses. High tan δ is traced to presence of Na naphthenates, arising from alkaline wash used in refining. 0·01% Na naphthenate can increase tan δ by a factor of 15, effect is more marked at higher temp. Recommended that water-wash (2 stages) be introduced, which eliminates such losses. Dielectric losses of oils can likewise be reduced by clay treatment, but at expense of oxidn stability. Present (unofficial) tan δ standard of 0·3% max at 20° C is inadequate, and losses should be measured at higher temp, nearer operating temp of oil. V. B.

DERIVED CHEMICAL PRODUCTS

376. Oxygenated petrochemicals. Pt V. P. W. Sherwood. *Petrol. Engr*, 1956, **28** (10), C11–16.—The new process for obtaining acetone as a by-product in hydrogen peroxide manufacture is described, namely by the controlled oxidn of *iso*-propanol by mol oxygen in the presence of a small amount of peroxide. Production of C_2–C_4 aliphatic acids is carried out from the parent hydrocarbon by 2-stage oxidn, *e.g.* (of outstanding importance)—

$$CH_3CHO + O_2 \xrightarrow{\text{Mn salt}} CH_3COOH \text{ (yield 95–98\% acid)}$$

as opposed to direct alcohol oxidn, when dilute aq acid is produced and it is difficult to control the temp of the highly exothermic system. The corresponding aliphatic anhydrides can be obtained by 4 principal petrochemical routes: (1) the ethylidene diacetate process; (2) subsequent oxidn of the acetaldehyde fraction; (3) acetic acid cracking; (4) acetone cracking. There follow methods of manufacturing the miscellaneous derivatives of the lower aldehydes and ketones. Finally, the production of oxygenated petrochemicals such as ethers and esters from C_2–C_4 hydrocarbons is discussed. E. A. G. H.

COAL, SHALE, AND PEAT

377. Research on synthetic liquid fuels by U.S. Bureau of Mines. Anon. *Petrol. Times*, 7.12.56, **60** (1548), 1101.—Progress by U.S. Bureau of Mines during 1955 on development research on production of oils from coal and oil shale is reviewed. Subjects include (Pt 1) hydrogenation of coal, Fischer–Tropsch syntheses, production and purification of synthesis gas, whilst Pt 2 deals with oil from shale. G. A. C.

MISCELLANEOUS PRODUCTS

378. Non-flammable paint strippers. Pt 3. Activators, thickeners, evaporation retarders. B. Berkeley, D. Schoenholz, and M. Skrypa. *Soap, N.Y.*, 1956, **32** (10), 152.—The authors' investigations into the role of additives used in the formulation of non-flammable paint strippers are reported.

Activators in paint removers enhance the penetration of the solvent into the paint film. A table shows the effect of acid activators in methylene chloride. The relative action of acetic and formic acids and the difference in performance among various amines are discussed. Formulations were prepared with several different acids and bases for the purposes of exploring the solubilities of possible activators.

The more important thickening agents are the cellulose derivatives. A series of compatibility tests was performed with thickeners for use in methylene chloride paint removers. D. K.

CORROSION

379. A laboratory method for the evaluation of oil production corrosion inhibitors. D. B. Boies. *Corrosion*, 1956, **12** (8), 371–5t.—A test method used to screen and evaluate oil well corrosion inhibitors is described, and the effects on inhibitor performance of such variables as temp, oil–brine ratio, aromatic content of oil blend, and composition of gas phase are shown graphically. Field tests show the method to be quite successful. W. G. R.

380. Corrosion of concrete condenser-water sewers. J. Zahodnick. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 116–24.—Various phases of an investigation of the severe corrosion

of a concrete condenser-water sewer at Esso Standard Oil Co's Bayway refinery are presented. Included are descriptions of lab and field inspections, as well as a detailed procedure used for identifying bacteria. Mechanism of the concrete corrosion process and the repair method employed are also discussed. (Author's abstract.)

381. Cooling-water treatment pays off. R. J. W. Dilliplane, J. J. Hur, and D. A. Wrigley. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 110–15.—Glassy-phosphate (Calgon) treatment of cooling water at a fluid cat-cracking unit reduced maintenance resulting from corrosion and improved heat-transfer capacity at a cost of approx $5000 p.a. An immediate dollar saving, more than 3 times the cost of the treatment, was realized from a reduction in compressor fuel consumption.

The system described is of the open-cooling-tower type, circulating 16,000 gal/min of water through 45 coolers and condensers which had incurred severe corrosion. Wartime use of steel tube sheets with admiralty tubes had created local corrosion problems in addition to general deterioration. Field studies, which are briefly described, indicated that dosages of 8–10 p.p.m. of Calgon were required for max reduction in corrosion—of the order of 85%—within economical limits.

Studies of the main-column condensers were also made in order to discover the effect of the treatment on fouling. The results showed that " clean " surface-heat transfer rates were being maintained. Chlorination and pH control supplemented the phosphate treatment. (Authors' abstract.)

382. Deterrence of hydrogen blistering at a fluid catalytic cracking unit. B. W. Neumaier and C. M. Schillmoller. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 92–109.—This paper deals with Richfield Oil Corpn's effort to avoid low-temp hydrogen attack at a new fluid unit, and to be able to detect and control the same if it does occur.

This is accomplished by removal of most sulphides, and a large portion of other acidic cpds, early in the process stream. Hydrogen sulphide is absorbed in a diethanolamine soln ahead of the second-stage compressor, and an extensive water wash is applied at the main fractionator overhead and at the first-stage compressor aftercoolers. Of the 134,000 lb/day of corrosive constituents, only 16,000 lb/day reach the gas plant. Additional protection is provided for the de-ethanizer and depropanizer overhead equipment by caustic washing and drying of the feed to these towers.

2 vulnerable locations are created, namely, (1) the towers and overhead equipment of the diethanolamine stripper, and (2) the sour-water reclaimer. Both are protected by a corrosion inhibitor; also, the feed to the water reclaimer is neutralized.

Polysulphide injection facilities are on standby to transform the cyanide promoter into harmless thiocyanate and to protect the vessel walls at the fractionator overhead and first-stage compressor systems. Inhibitor facilities are available for additional protection at the absorber-demethanizer and at the debutanizer overhead equipment. (Authors' abstract.)

383. Use of neutralizers and inhibitors to combat corrosion in hydrocarbon streams. R. J. Hafsten and K. R. Walston. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 80–91.—This paper summarizes the accepted practices for mitigating corrosion by means of neutralizers and inhibitors. These methods are chiefly effective against low-temp corrosion caused by the absorption of the acid gases—hydrogen chloride and hydrogen sulphide—in condensed moisture to form the corresponding acid. Some neutralizers are used to combat high-temp corrosion, but, in general, the use of alloy equipment is a more realistic approach to this type. The neutralizers commonly used are caustic, soda ash, ammonia, lime, and a number of special-purpose materials. Each of these neutralizers is discussed, along with the reactions involved and the relative advantages of each type for general cases. Many of the corrosion problems can be more economically solved by the combined use of neutralizers and inhibitors. The functions of the inhibitor as a corrosion preventive and as an anti-fouling agent are outlined in theory as well as illustrated by the experiences of the refiners who have used them. The film-forming inhibitors have definite temp limitations and pH requirements which frequently require that ammonia injection be practised in addition to the inhibitor addition.

Tables of data are included which show the results of the survey conducted and which illustrate the procedures many refiners are following. The points of injection, the method of control, and the effectiveness of the system are points of interest noted in the tables. (Authors' abstract.)

384. The cathode protection of metallic structures in marine environments. W. A. Bowen, Jr. *Corrosion*, 1956, **12** (7), 317–21t.—Theoretical and practical considerations, including anode location, polarization, and economics, involved in using cathodic protection in sea water are noted. Specific cases of cathodic protection mentioned include dry docks and ships. Means of checking the effectiveness of a system are reviewed and discussed. W. G. R.

385. Polyethylene tape cathodic protection. M. E. Parker. *Pipe Line News*, 1956, **28** (8), 38–40.—Pipe coatings of polyethylene tape and of coal tar saturated asbestos felt were tested on adjacent sections of an 8-inch dia steel pipeline. Whilst the coatings were comparable in total applied cost, after 6 months the former coating had a superiority of 3 : 1 when compared on the basis of current required for cathodic protection. The durability of the coating also appears to be promising. D. B. S.

386. Pipeline coating practices. A. McClure. *Pipe Line News*, 1956, **28** (6), 41–7.—A pipeline coating should have good electrical resistance, be impervious to water, easy to apply, and be of a uniform nature and thickness. Fully plasticized coal tar coatings satisfy these requirements and these have a service temp range of −20° to 160° F. Straight-run coal tar pitches are harder, but the temp limits of 32°–120° F are not suitable in many cases.

Accepted thickness is $\frac{3}{32}$ inch, and it is found in practice that a figure (pipeline dia in inches × 0·7) gives tons of coating/mile. Primer required is 4 times this amount. Asbestos felt wrapping is used to protect the coat, a single coat double wrap being normal. The application costs are discussed, and it appears that for pipelines less than 30 miles in length precoated pipe is normally used, above 30 miles travelling coating and wrapping machines become more economical, depending on the site, etc. Problems associated with the coating, laying, and backfilling, and also methods of testing are discussed. Coating costs usually amount to *ca* $\frac{1}{3}$ pipe cost. D. B. S.

387. H_2S corrosion in Soraformers. E. B. Backensto, R. D. Drew, and J. N. Vlachos. *Petrol. Process.*, 1956, **11** (10), 64–8.—In some cat reformers, hydrogen sulphide corrosion has become a serious problem. An iron sulphide scale is formed at high temp by the reaction of H_2S (particularly in a hydrogen-rich atm) with commonly-used materials of construction. Usually, the actual metal loss is small, but the scale formed may spall off and eventually cause plugging. Socony Mobil Oil Co Inc has reported results of its own lab work. These results show that H_2S corrosion can be lowered by: (1) reducing H_2S in process streams; (2) using chromium–nickel austenitic steels; and (3) protecting metals by aluminizing. As a result of field and lab tests, most Soraformers now have a pretreater to desulphurize the charge below 0·002 wt% total sulphur. At this sulphur level, corrosion on carbon and low-chromium steel will be negligible in the Soraformer. J. H.

ENGINES AND AUTOMOTIVE EQUIPMENT

388. Gas turbine ship performance. Anon. *Mot. Ship*, Nov 1956, **37** (438), 296.—The performance of G.T.V. *John Sergeant* during her transatlantic crossing is considered. On arrival at Southampton her machinery was inspected by representatives of the shipping and marine engineering fields. Plans and photographs of the engine room and engine are included. Plant particularly noted is the fuel oil washing plant and that for utilizing exhaust gas for boiler heating. The lack of noise and vibration is a point stressed. D. K.

MISCELLANEOUS

389. Future outlook of petroleum in the world. C. E. Reistle. *J. Petrol. Tech.*, 1956, **8** (11), 14–18.—After world war II political and industrial developments have differed from expectations, and instead of a major recession, economic growth in the past 10 years has been much greater than in any similar period in history. In 1946 total world oil needs were $7{\cdot}8 \times 10^6$ b.d.; in 1955, $16{\cdot}1 \times 10^6$ b.d. Gasoline requirements have nearly doubled; the same is true for kerosine, and the needs of other dist fuels have more than doubled. Armed forces, increase in life expectancy, and ease of communication have all contributed to the rise in consumption.

A study of capital expenditure by 30 major oil companies shows the 1954 figure to be *ca* 2½ times that for 1946. The major investments have been in the U.S.A., the Middle East, and northern S. America; these areas had a suitable economic climate for attracting risk capital. Expenditure on research has risen even more markedly, and benefits have accrued in the exploratory and exploitation phases as well as in refining.

Marked production increases have taken place in the Middle East, Canada, and Europe. There has been a trend to locate refining facilities near marketing areas.

Recent trends are generally expected to continue during the next decade, but the demand outside the U.S.A. may in a few years exceed that in the U.S.A. Solar and atomic energy seem to hold no serious threat to the increased use of petroleum products. Many areas hold attractive oil possibilities that are far from adequately investigated, and foreign companies are now searching for oil in many countries that have no appreciable oil production. New reserves of important size have also been found in old areas. G. D. H.

390. Radiological safety in the petroleum industry. B. A. Fries. *Oil Gas J.*, 19.11.56, **54** (81), 200.—Applications of radio-isotopes and nuclear radiations in the petroleum industry are reviewed, and the radiation hazard discussed. Radiation regulations, protection from external radiation and internal radiation, tolerance limits, and waste disposal are dealt with, and safety training and safety practice outlined.

A table shows max permissible quantities of radio-isotopes, and lab safety reminders are listed. G. A. C.

391. Lesson from the Whiting explosion. Anon. *Oil Gas J.*, 19.11.56, **54** (81), 132.—Findings of an engineering study of the detonation at the Whiting plant of Standard Oil Co, Indiana, are given, and show that established concept of pressure generation of explosive mixtures in plant falls far short of possibility, that conventional pressure-relieving devices are not enough, and that further precautions are necessary. G. A. C.

392. The significance of the Iraq pipelines. Anon. *Petrol. Times*, 23.11.56, **60** (1547), 1051.—The economic, cultural, and political implications following the damage to pumping stations in Syria, Iraq, and Lebanon are reviewed. G. A. C.

393. Further abstracts of papers presented at Dallas, Texas, April 1956. Petroleum Division of the American Chemical Society. Anon. *Petrol. Times*, 26.10.56, **60** (1545), 964.—Abstracts are given of a further 29 papers, under the subjects of exploration and production and of chemicals from petroleum. G. A. C.

394. Radioactivity in research and refinery operations. Anon. *Petrol. Times*, 7.12.56, **60** (1548), 1107.—Abstracts are given of papers presented at a symposium by Tracerlab Inc held in Boston, Mass., Oct 1956, and includes, among other subjects, safety and management considerations in the use of radioactivity, development of industrial uses of isotopes, detectors, instrumentation, radiation chemical processing, tracer studies of cat behaviour, and measurement of fluidized solid and liq flow rate. G. A. C.

395. Radio-isotopes in the oil industry. M. Grenan. *Rev. Inst. franç. Pétrole*, 1956, **11** (5), 684–95.—Radioactivity and neutron logging is used in wells, and radioactive marker bullets and tracers for locating the top of cement have also been employed. Isotopes allow the checking of the arrival of injected water at a producing well, and the detection of zones in which acids have been injected.

In clearing new pipelines a tracer on the go-devil permits the more easy detection of its position if it is held up by a blockage. The interface between two batches of oil can be marked by putting in a radioactive tracer.

In a refinery, radioactive tracers permit the location of the levels of solids or liq in inaccessible places, while isotopes can be used for inspecting equipment. Research on fluid movements in porous media, on refinery techniques, adherence of asphalt to road stones, lubrication, and on detergents has been helped by the use of radio-isotopes. G. D. H.

396. Reactions involving ozone, nitrogen dioxide, and organic compounds at low concentrations in air. P. L. Hanst, E. R. Stephens, and W. E. Scott. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 175–87.—Periods of temperature inversion in Los Angeles are frequently accompanied by severe smog attacks. Usually the severity of smog, as judged by the decrease in visibility, gradually increases during the morning hours to a peak around noon and then decreases. This behaviour indicates that sunlight plays an important role in the development of smog. It suggests that photochemically initiated reactions among the various pollutants present in the air are of major importance. Another close correlation with smog severity is observed in the measurements of oxidant concentration in the atmosphere. Studies of this oxidant have indicated that it is probably ozone.

This paper is a report on a study of the reaction of various hydrocarbons with ozone and with nitrogen dioxide in artificial sunlight and air. Experiments were performed at partial pressures of reactants of the order of 1 mm Hg. A carbon arc was used as a source of u.v. radiation. After passage through a pyrex flask, this radiation approximates sunlight both in intensity and spectral distribution in the u.v. region. I.r. absorption was used to analyse the products of reaction.

Representatives of 4 types of hydrocarbons were studied,

namely (1) 1-olefins; (2) straight-chain saturates; (3) branched-chain saturates; (4) saturated cyclics. Emphasis was placed on the study of 1-pentene. The saturated hydrocarbons proved to be much less reactive than the 1-olefins.

When mixed at partial pressures in the millimetre range, ozone and 1-pentene react very rapidly to produce gaseous products and a liq mist. There is evidence of the transitory formation of an ozonide. Butyraldehyde, carbon dioxide, and carbon monoxide—but not formaldehyde—are identified in the gaseous products. With excess ozone some of the butyraldehyde is oxidized to peroxy acid. Reaction of ozone with a series of straight-chain aldehydes showed that the 3- and 4-carbon aldehydes produced the most peroxy acid.

The photochemical reaction of ozone with 2-methylpentane produced an unidentified carbonyl cpd, carbon dioxide, and acetone. *n*-Hexane and *cyclo*hexane were both less reactive with ozone than 2-methylpentane.

Under " sunlight " irradiation 1-pentene reacts with nitrogen dioxide in air to produce aldehyde, carbon dioxide, propyl nitrite, propyl nitrate, and peroxy acid. The nitrite and nitrate are not formed when 1-pentene is photochemically reacted with nitrogen dioxide in nitrogen rather than air. Propyl nitrate is also produced when butyraldehyde is reacted with nitrogen dioxide under "sunlight" irradiation in air. If pure nitrogen is substituted for the air, propyl nitrate is not produced. In contrast, the reaction between peroxy butyric acid and nitrogen dioxide produces the nitrate and nitrite, even without mol oxygen. It is concluded that in the 1-pentene–nitrogen-dioxide reaction, alkyl nitrite and alkyl nitrate are produced by the reaction of nitrogen dioxide with the peroxy butyric acid first produced.

The photochemical reaction of nitrogen dioxide with 2-methylpentane produces alkyl nitrate, alkyl nitrite, carbon dioxide, acetone, and probably another carbonyl cpd. Mol oxygen is necessary for the formation of the nitrite and nitrate. Nitrogen dioxide reacts more rapidly with 2-methylpentane than with *n*-hexane or *cyclo*hexane. (Authors' abstract.)

397. The concentration of ozone in the atmosphere of certain American cities. J. Cholak, L. J. Schafer, and D. W. Yeager. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 164–74.—The purpose and scope of the investigation are described briefly. The data obtained in a preliminary investigation of the atmosphere in 10 cities and the progress which has been made since then are reviewed.

The levels of concn of oxidant which were found in the atmosphere varied inversely with the concn of sulphur dioxide which was present. The concn of oxidant was generally so low as not to lend itself to correlation with meteorologic variables. The relatively high levels of concn of oxidant which have been found in Los Angeles during periods of fog and inversion were not encountered in the cities investigated.

The levels of concn of nitrogen dioxide found in the atmosphere during an extended period of investigation in Washington, D.C., bear no demonstrable relationship to the density of motor traffic. The concn of carbon monoxide in the atmosphere reached its peak generally during the period of max traffic. (Authors' abstract.)

398. The formation of ozone in polluted atmospheres. L. M. Richards. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 155–63.—Atmospheric pollution in urban areas which derive heat and power largely from petroleum products is characterized by the occurrence, during daylight, of high concn of oxidizing agents. Evidence indicates that the principal oxidant is ozone, in a complex system which also contains oxides of nitrogen, peroxides, ozonides, and possibly free radicals. The materials in polluted atmospheres which produce these oxidants have not been completely identified and are termed " precursors." It was determined experimentally that the formation of oxidant from precursors requires light with wavelengths below 4000 Å. The precursors were removed or destroyed by activated carbon, copper oxide at 760° C, and by a liq-oxygen-cooled trap, but were not materially affected by reagents designed to remove nitrogen dioxide, organic acids, aldehydes and ketones, organic bases, and particulate matter, nor by dry-ice-cooled traps. Precursors, removed by a liq-oxygen-cooled trap, could be recovered and efficiency of the removal and recovery were measured. Attempts were made to identify the precursor by use of the mass spectrometer, and the u.v. and i.r. spectrometers. Hydrocarbons are the principal substances present in the precursor.

Precursors, collected in a liq-oxygen-cooled trap, through a dry-ice-cooled trap, formed large quantities of nitrogen dioxide and oxidant when irradiated, or when mixed with ozone. It was confirmed that nitrogen dioxide and organic cpd mixtures at realistic concn in air will also form oxidants (believed to be largely ozone) when irradiated. A proposed mechanism for the reactions involved is described. (Author's abstract.)

399. Automation of production and management. R. L. Ackoff. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 192–6.—The petroleum industry has been a leader in mechanization of production and in the application of centralized remote-control systems. In automatic control systems, mechanical computers replace human operators as the link between detection instruments and control devices. These systems make possible continuous, simultaneous control of a number of production lines, resulting in better and more consistent quality yield at lower cost. " Operations research " provides the bridge to a similar mechanization and automation of management. Once " operations research " has developed mathematical models of an industrial system, these models can be fed to electronic " brains," *e.g.* UNIVAC or the IBM 701. Such a " brain," when connected to a data-processing system at one end and an automatic factory at the other end, can replace a human manager. However, just as mechanization and automation have not created unemployment among workers, neither will they do so among management personnel. Human managers will be needed to control the automatic manager and to handle those complex problems which can never be completely mechanized. (Author's abstract.)

400. The tools of automation. L. N. Ridenour, Jr. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 197–201.—Automation, as exemplified by mathematical computing machines, mechanized clerical operations, on-line control in the continuous-process industries, and mechanized discontinuous fabrication and assembly operations, is old. However, modern developments in electronics have greatly expanded our ability to apply the techniques of automatic information processing and automatic control. Applications of automatic devices in continuous-process control, such as is required by the petroleum industry, is more complicated than purely mathematical or clerical applications because of the greater variety of input and output information which must be handled, the necessity of operating in " real time," and the high reliability required. Every effort is made to use non-electronic, analogue devices whenever the operation is not too complex. The use of transistors, magnetic cores, and other solid-state devices in place of vacuum tubes has made possible the application of digital techniques to complex control problems in the processing industry. The requirements of discontinuous manufacturing operations are similar to those of the continuous-process industries, except that the input and output devices are still more complicated. (Author's abstract.)

401. The impact of automation on business enterprise, economy, and society. P. F. Drucker. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 202–5.—Automation, far from replacing man by machines, depends on the knowledge, competence, responsibility, and motivation of people to a greater extent than does

any other method of production. It leads to long-range social and economic stability by stabilizing production, employment, and capital investment. In most manufacturing industries automation will increase product diversity and flexibility. As a consequence of the stabilization of production rates over long periods, the risks of business will have to be met by improved marketing operations. Labour will become a critical resource. The production jobs which are eliminated by automation will be replaced by new jobs requiring greater knowledge and skill. (Author's abstract.)

402. Education is everybody's business. J. E. W. Sterling. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 19–22.—The U.S.A. has offered more education to more people than has any country in the world. That is the prime reason that education has become everybody's business. Another reason lies in the nation's dependence for progress and security on the trained manpower which its educational system produces. This educational system derives much of its strength and freedom from the diversity of its institutions. If this diversity is to be continued, private colleges and universities must be kept strong. American colleges and universities need to continue the improvement of faculty salaries in order to compete effectively for first-rate manpower, especially at a time when college and university enrolments are increasing. It is in the nation's interest that this be done. Co-operation between business corporations and universities can do much to facilitate the solution of important educational problems.
(Author's abstract.)

403. Planning and developing the management organization. L. Fish. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 135–40.—The primary elements of the management process at any level are planning; organizing; selecting, training, and developing personnel; providing leadership, guidance, and co-ordination; and controlling results. Unless individual responsibilities are properly defined, even the most competent management team cannot administer large operations efficiently. Poor organization results in an unnecessarily large number of management personnel. Responsibility for conducting the affairs of each logical operating component should rest with a single, competent executive or supervisor, whose job it is to get essential results at minimum cost, with fewest people, by the best methods and simplest procedures. An effective member of the staff organization must have a broad background of knowledge, strong powers of perception, ability to analyse, marshal, and present the facts, and skill in " facilitating " the efforts of operating management. (Author's abstract.)

404. A procedure for training process-unit operating personnel. O. C. Day. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 132–4.—Continued emphasis on manning process units at Esso Standard Oil Co's Baton Rouge refinery with the right number of employees, and on improving the quality of work performed by these employees, has led to the establishing of a formalized training programme for process personnel. This programme was proposed to the union during negotiations for a new bargaining agreement in the summer of 1953. A committee composed of 3 management representatives and 3 union process representatives was appointed to work out a proposal agreeable to both. This was done, and the programme became a part of the new bargaining agreement.

All process employees in classifications below first helper (351 employees) were automatically entered in the programme on 1 Oct 1953. Concessions were made to this group because of their previous process experience. As a result of this programme, 2 former process classifications were eliminated.

Although difficult to evaluate because of the relatively short experience factor, indications are that higher yields, higher production rates, and less unit downtime are being obtained.
(Author's abstract.)

405. Supervision : key to effective communication. M. E. Stone. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 127–31.—For most companies the problem is not " Should we communicate with our employees? " Management is aware that communication, in one way or another, is taking place all the time. The real problem lies in seeking orderly methods of exchanging information, particularly on subjects which are vital to the company's and employees' mutual interests, but which lie outside the boundaries of routine communication.

There are many things which employees want to know, which management equally wants them to know. It is important that management satisfy this employee need in the most effective way. Devices such as publications, bulletins, and public announcements are effective—but only to a limited extent. In human relations there is no complete substitute for human-to-human communication. As the front-line management representative, supervision is, therefore, the most effective medium for management's permanent communication programme. This, in turn, emphasizes the need for careful development of the people in all levels of supervision.

It is not enough for management to do its communication " thinking " in terms of the rank and file. Every stratum of supervision has essentially the same need for channels through which to hear from management and to speak to it. Working out a successful programme presents many difficulties; but with the right amount of management effort, they can be overcome. The rewards to be realized from a successful programme make it worth while to accept the challenges.
(Author's abstract.)

406. National defence. J. H. Doolittle. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 23–7.—In view of the Soviet Union's avowed goal of world communization and world domination, the wisest U.S. policy is to maintain the peace through military strength and to exert the pressure necessary to cause the Soviets to change their objectives. Meanwhile, it must preserve its own freedom and, if possible, strengthen its economy.

Pending the solution of the major ideological conflict, the U.S.A. can strive to remove the possibility of a surprise attack by building up air-atomic offensive power. The new jet aircraft require a tremendously increased amount of fuel as compared with conventional aircraft. The petroleum industry could make a valuable contribution to national defence and national security by providing an unconventional fuel, which might well consist of other than strictly hydrocarbon cpds and would have more energy per pound and per gallon, without prohibitive cost, than present fuels. (Author's abstract.)

407. Foreign review and current news. Anon. *Nafta (Krakow)*, 1955, **11**, 121–4.—Completion of Soviet 1954 Plan. Although plan has been exceeded by 3% individual works and oilfields often were not 100% successful. Whilst staff were fully employed for part of the time, they were slack at other times, thus reducing efficiency. Compared with 1953, crude production rose by 12%, gasoline by 9%, kerosine by 5%, diesel fuel by 44%, natural gas by 9%, pest control chemicals by 35%. Drilling speed went up by 5–6% and refining losses fell.

Polish production in April: Plan was exceeded in crude by 2·4%, natural gas by 9%, gasoline by 10·4%. Drilling plan was exceeded by 19·8%. New muds factory, based on work done by the Polish IP, has been suggested. M. S.

BOOK REVIEWS

Oil Fuel Applications. A. T. Henly. London: Crosby Lockwood, 1956. Pp. ix + 250. 35*s*.

There is clear evidence of the urgent need for a British, as distinct from an American, book on this subject. The author is to be congratulated on his energy in accumulating a vast amount of information which is not normally readily available.

In spite of its title the book consists essentially of 101 pages on the storage and handling of liquid fuels, 30 pages on oil burning equipment, and 44 pages on ancillary equipment and controls. Of the rest of the book some 17 pages are devoted to boilers and space heaters and only 13 pages on all other applications. It would be useful if this last part could be considerably expanded, as it seems regrettably brief compared with the 12 pages devoted to the auxiliary systems of diesel engines. As far as details are concerned, Table 1 flatters town gas as having no sulphur content. Even in its purified state it contains about 30 grains/100 ft^3, which is equivalent to 0·1% by weight, *i.e.* of the same order as that of kerosine.

With regard to Fig 1 on p. 10, a warning should be given that in the low temperature zone the viscosity temperature curves may depart from the straight lines indicated.

In Table 16 on p. 61, the cost of heating with electricity is presumably based on a use of 24 units/ton. For a fully automatic burner the theoretical requirement would be about 40 kW.h/ton of oil and in practice, due to the external losses during running and idling periods, the consumption is more likely to work out at 80 units/ton. With regard to Table 20 on p. 79, it might be indicated what type of tank is concerned; presumably it is a horizontal cylindrical tank, because otherwise it is difficult to see why the heat transfer factor should be greater on top than that at the sides. The reverse would be true for a vertical cylindrical tank.

Chapter 5, dealing with oil burning systems, requires amplification and clarification. Here reference is made to the supply of air to high and medium pressure air burners from fans when they are always applied by rotary or reciprocating suppressors. Rotary cup burners are labelled "mechanical atomizing burners," which is unfortunate because that is the term applied in America and many other parts of the world to pressure jet burners. There is some doubt as to what the author means by "controlled pressure-jet." On some pages it would appear that the author means a wide-range pressure jet (Table 30), while from the description given on p. 119 it would appear that the author has an intermittent pressure jet in mind. On p. 120 mention is made of the Brockhouse oil burner, Fig 75, as being a preheating burner, but the figure clearly illustrates a light oil non-preheating burner.

When dealing with boiler chimneys on pp. 150–4, the author might have mentioned the danger of the sulphuric acid from the products of combustion condensing on the relatively cold walls of bare steel chimneys and hence the desirability of insulating the chimney, preferably on the inside.

The chapter on oil-fired boilers could be usefully enlarged to deal in more detail with the firing of shell-type boilers and large water-tube boilers.

With respect to bakers' ovens, Table 38 on p. 197 could with advantage be omitted from future editions because clearly the temperature at which one bakes buns, cakes, etc., in no way depends upon the fuel being used to heat the oven.

In the last interesting chapter on maintenance and trouble tracing, mention should have been made of the paper filter smoke meter which is rapidly becoming a *sine qua non* for service engineers and without which the CO_2 alone does not give an idea as to whether combustion is satisfactory. On the last page of this chapter, although the paragraph is headed "Maintenance of Domestic Oil Burners," reference is made to the oil preheater, although 99 out of every 100 burners used for domestic purposes are non-preheating, using a light distillate oil. It is very doubtful whether it is of economic advantage to use a preheating burner for domestic use unless the building concerned is of palatial proportions.

As "Oil Fuel Applications" is likely to become the handbook of the burner industry and the central heating world, one hopes that a second edition will be rapidly produced with omissions filled in and certain errors corrected. In the meantime a welcome should be given to this book and to the author for having collected within one cover so much useful data. It is to be regretted that international events have overtaken the issue of the book, making Table 41 and some of the matter in the introduction read somewhat strangely at the present moment. G. J. G.

Gas Chromatography. Courtenay Phillips. London: Butterworths Scientific Publications, 1956. Pp. x + 105. 25*s*.

Gas chromatography, one of the most promising of the new methods of separation and analysis, has developed extremely rapidly in the last few years and is being applied in a continuously expanding field both in Europe and America. It is appropriate that Mr Phillips, as one of the small group in this country who pioneered the technique, should be the author of the first book exclusively devoted to this latest form of chromatography.

His aim has been to fill the need of the many, who are now entering the field, for a broad survey of the history and development of the method and particularly a critical assessment of the variety of experimental procedures and apparatus already developed. In this he succeeds admirably, the chapters devoted to general apparatus requirements and vapour detectors being especially useful. The description of the hydrogen flame detector, however, tends to give a false picture of its mode of operation. Under conditions where the flame engulfs the thermo-junction, the detector becomes non-linear. Best linearity is achieved when the distance between the junction and jet is adequate to reduce the effect of the flame-lengthening.

From the viewpoint of the analyst the treatment of the quantitative aspects could well have been expanded, but insufficient detailed information on the characteristics of most detectors has yet been published. The data quoted for the widely used thermal conductivity cell are misleading in that normalization of the peak areas without calibration, when using hydrogen or helium as eluent gas, gives results nearer to weight rather than the mol per cent composition. The brief comparison of the technique with distillation and spectroscopy in the introduction will be of particular interest, but perhaps undue emphasis has been placed on a simple numerical comparison of theoretical plates values for distillation and chromatography columns.

The chromatographer will be a little disappointed with the book, especially the chapters on theoretical principles and separation efficiency. The author adds little to the published literature and gives small consideration to the future possibilities and new applications of this versatile technique. This may well be outside the scope of this small

book, however, which will be most valuable as an easily readable and informative introduction to the subject.

D. H. D.

Lubrication of Bearings. F. T. Barwell. London: Butterworths Scientific Publications, 1956. Pp. xii + 292. 50*s*.

Since the decade 1880–90, when Towers and Reynolds established the principles of hydrodynamic lubrication, there has been a continuous flow of research by many schools on the fundamentals of lubrication. Dr Barwell and his co-workers at M.E.R.O. are amongst the latest in the series and have already established a world-wide reputation for their work on the theory and practice of lubrication.

In the present book Dr Barwell gives a summary of the outstanding work of the last 50 years, with particular reference to the lubrication of bearings, including his own more recent and original work. This he has done in a most readable form, helpful to both research workers and practising design engineers.

It is a far cry from the ox-wagon axle to the gas turbine bearing. Modern requirements involve increased severity in regard to speed, load, and precision, and modern design must depend on principle, not chance, in the design of bearings.

Although it may be true that there is little change in fundamental theory since Reynolds and that there is still much to be learnt, the research worker today has available more powerful instruments which reveal much that was hidden to earlier workers. As a result he has a much better understanding of the nature of surfaces and the molecular interactions between them which enables him to provide the designer with more precise data about his materials and requirements.

The author has brought together in the first half of the book a résumé of this modern knowledge of surfaces, lubrication, and bearing materials, and in the second half has applied this knowledge to the practical aspects of bearing design. He has endeavoured to sort out scientific principles and solid fact from engineering tradition and to bridge the gap between the outlook of research and the problems of the practising engineer.

Dr Barwell has succeeded admirably in his task. In spite of the enormous amount of information which is packed into the book, it is concise and lucid in style, compact in volume, and enjoyable to read. It is also a valuable reference book for both designer and research worker.

W. P.

Electrostatic Precipitation. H. E. Rose and A. J. Wood. London: Constable, 1956. Pp. 166. 17*s*. 6*d*.

This excellent monograph on the theory of the electrostatic dust precipitation gives, for the first time under one cover, a concise and practical résumé of the known and accepted approach to this complicated subject. No attempt is made to gloss over the imperfections and gaps in the theory, and one is left with the expectation that the authors will produce in time a new volume in which the major imperfections will have been adequately covered by their own efforts.

The authors' discussion demonstrates that the exploration of the behaviour of a particle in an electrostatic field lies in a more complete knowledge of the part played by the individual physical and electrical properties of the particles and the electrodes. The authors make no mention of the behaviour of semi-conductors such as carborundum powders in fields produced between electrodes of finite resistance, but it has been effectively demonstrated elsewhere that the relationship in such a system between the electrode and particle constants, and in particular their bulk and surface resistances, plays a major part in controlling precipitation. It would appear that a theoretical study of a system of this type should be capable of explaining a large proportion of the discrepancies in the present theory and would also offer a method of predicting the conditions necessary to precipitate with the greatest efficiency any material once its electrical and physical constants have been established.

The volume is remarkably free from misprints, only one being noticed (p. 150, last paragraph, the word "charging"). The somewhat poor reproductions of the photographic illustrations detract somewhat from their value, as such detail as the twisted wire electrodes in Fig 7.1 particularly referred to on p. 121 cannot be resolved.

The book will no doubt be very useful as a handy reference on the subject, and its value in this connexion is enhanced by a reasonably extensive bibliography.

F. W. W.

Industrial Research. Advisory Ed. Percy Dunsheath, C.B.E. London: Todd Publishing Group, 1956. Pp. 444. 63*s*.

Sir Norman Kipping points out in a contribution to this book that something like half of the products of industry today were unknown at the turn of the century. These are the fruits of research carried out by industry itself to a large extent, but based on fundamental research at the universities. Nowadays there is a growing tendency for industry to devote a proportion of its research funds to basic research and at the same time for the universities to extend their work into the applied research fields of direct value to industry. In between are the Government research establishments and the industrial research associations, many of which are financially supported by the Government.

It is essential for industry to keep in touch with universities and other organizations carrying out research in which it is interested, but this is becoming a more and more difficult matter owing to the diversity of research subjects and the expanding research facilities. This book sets out to provide a guide to the organization and scope of the industrial research being carried out in this country by universities, technical colleges, Government laboratories, research and development associations serving industry, and private firms.

The present edition of "Industrial Research" has been very considerably expanded over the previous 1947 edition, and contains a number of new features, including a series of short articles on different research topics, such as income tax implications and careers in professions associated with industrial research. It also contains useful information on the organization of the Atomic Energy Authorities, both in the U.K. and overseas, directories of the Government and public bodies with research divisions, British and overseas organizations interested in industrial research, lists of consultants, professional societies, and journals providing research information, abstracts, etc.

The encyclopædic nature of this book will make it of value to all interested in research, particularly from the point of view of indicating where research is being carried out on any specific problem. It should also prove of value to science masters in indicating to potential science students the diversity of research fields, and the courses available at different universities.

While the book is expensive, there is no other source from which the information can be readily obtained, and it is highly recommended.

C. L. G.

Industrial Furnaces. Vol. 2, 3rd Edn. W. Trinks. New York: John Wiley, London: Chapman and Hall, 1955. Pp. x + 358. 80*s*.

In the latest edition of Vol. 2 of "Industrial Furnaces," the author has produced another book which is invaluable to the furnace designer.

The book deals with the nature of commercially-available fuels and their application to industrial furnaces, mainly in the steel trade. Where necessary, the original text has been amplified in order to bring the reader up to date with modern American practice, and it has also been modified where practical experience has shown this to be warranted.

More attention has been paid to electrical heating, and reference is made to an interesting development in Italy using molten glass as a resistor in an electrically-heated ingot furnace.

The use of liquid fuel is increasing in the U.K., and the chapter describing this fuel, together with different types of oil burners, is most helpful. It should be noted, however, that the properties of liquid fuels quoted are for American fuel oils and may not apply to oils available in the U.K., the bulk of which come from Middle East sources. Further data are provided on the design and capacities of gas burners.

The chapters on the control of furnace temperature and furnace atmosphere have been almost entirely re-written, the former describing up-to-date methods of instrumentation in addition to examining the various possible methods of regulating the temperature of furnace gases. In the section dealing with the scaling of steel, Trinks discusses the effect of reducing and oxidizing atmospheres and concludes that scaling will occur in any event in the presence of combustion gases at normal furnace temperatures. Reduction and oxidation diagrams are included for iron and various other metals. There is also a carburization and decarburization diagram for steel.

Practical methods of controlling combustion conditions are described for gaseous, liquid, and solid fuels.

The book concludes with a new chapter on safety measures. There are many new illustrations throughout.

J. G. C. P.

Chemistry and Uses of Pesticides, 2nd Edn. E. R. deOng. New York: Reinhold, London: Chapman and Hall, 1956. Pp. 334. 70*s*.

The change of name and scope of this book since the previous 1948 edition (from Insecticides to Pesticides) is an indication of the broadening chemical attack on the pests which attack man's food and endanger his health. The present edition has been completely rewritten, with considerable pruning of the matter in the previous edition and inclusion of data on recent advances in the pest control field. It provides a general guide to the chemical, physical, and toxicological properties of modern pesticides, with information on their conditions of usage, and makes reference to newer methods of pest control based on recent research. Emphasis is on the practical use of the product rather than on the research leading to its development.

It is frequently supposed that agricultural chemicals are indiscriminately used and the appendix in this book devoted to the U.S. regulations concerning permissible traces of insecticides on sprayed crops may provide some reassurance. When it is realized that in the U.S.A., in some cases, no residue is permissible and in others as low as 0·1 parts per million is allowed, it will be appreciated what this means to the company attempting to develop a new agricultural chemical in respect of field trials, development of microchemical analytical procedures, etc.

Attention may also be drawn to a table in the book which shows that the chemicals responsible for the largest loss of life are still alcohol and the barbiturates.

The book surveys in turn the main types of pesticide materials, quoting published data on their characteristics and the results of field trials. A section is devoted to petroleum and its products, although there does not appear to be any great advance in this field, possibly in view of the decreasing use of petroleum products as carriers for insecticidal materials.

Modern developments for pest control referred to in this book include the release of male screw worms sterilized by X-rays (with the interesting suggestion that chemical sterilizers might be more effective than chemical poisons for general control purposes), systemic insecticides, which render plants and even animals toxic to insects, and the increasing use of antibiotics, mainly as fungicides.

The book, and in particular the dictionary of 500 pesticide compounds which it contains, should prove of value as a source of reference to research workers, manufacturers of products, and users of insecticides, and is confidently recommended.

C. L. G.

The Black Bonanza. Earl M. Welty and Frank J. Taylor. London: McGraw-Hill, 1956. Pp. viii + 243. 37*s*. 6*d*.

This is another of the growing number of company histories, and a good one. Its subject is the Union Oil Company of California.

" Once an oilman always an oilman " seems to be as much the rule today as in the last century. But with the growth of the industry an increasing proportion of oilmen serve in the larger organizations, and each of these develops its own individuality. This individuality is felt by all the members of its staff, but, with the spread of its operations and the increasing specialization of each man's work, it is sometimes difficult for an employee to appreciate how this individuality has developed. This is where a book such as *The Black Bonanza* is so valuable; it traces the growth of the Union Oil Company from its first beginnings up to the end of 1955 not as an idealized smooth progression but giving as equal a weight to its failures as to its successes.

To readers in England it is perhaps the early part of the book which is of most interest. Lyman Stewart was born in 1840 near Titusville, Pennsylvania, right in the heart of the world's first oil centre. He became interested in oil even before " Colonel " Drake drilled his famous well. The book does well to remind us that the oil industry was in fact relatively well established before 1859, and the development of seepages and the digging of pits provided oil which found its way to many lands, largely for medicinal purposes.

Much of the book centres on the character and perseverance of Lyman Stewart and his early successes and failures in Pennsylvania, until he moved to California in 1883. There, first in partnership with Wallace L. Hardison and later with Thomas R. Bard, he met failure and success with equal composure. Often the failure seemed final, but gradually the successes mounted until the business became firmly established. By an amalgamation of three companies, including Stewart's, the Union Oil Company of California was formed in 1890.

Even then, things did not go smoothly, and the book describes in detail the bitter feud which developed between Stewart and Bard, the battles over control, the lawsuits which were threatened, and the efforts made by Standard of New Jersey, and even unspecified London interests, to buy out this growing and successful company. Much of its value was in the leases it owned, so wisely chosen and bought by Stewart himself.

The later part of the book is perhaps of most interest to the staff of the Union Oil Company. Though the accent has been predominantly on production, the company has always been in the forefront of technical progress in all sectors. It laid the first pipeline to seaboard, built the first tanker in the Pacific, and today holds a premier position as a fully integrated oil company. The book touches on some of its discoveries, such as propane deasphalting, and one wishes that rather more space had been given to these develop-

ments and possibly somewhat less to finance, debenture issues, mergers, and suchlike.

Pleasant it is to read that Lyman Stewart's son, two grandsons, and now a great grandson have served, or are serving, the Union Oil Company. Is it a record for one family to give continuous service to the oil industry for 100 years ?

M. E. H.

Fluidization. Ed. Donald F. Othmer. New York : Reinhold, London : Chapman and Hall, 1956. Pp. ix + 231. 56*s*.

This book is the only one which has so far been published offering an integrated body of experience and practicable working information on the fluidization of pulverized solids.

The subject is treated from an historical point of view by authors who have been closely associated with the development of commerical processing of petroleum using this technique, and the more academic side of fluid dynamics. Heat and mass transfer systems to be encountered in processing industries are also dealt with.

The book can be well recommended as a general introduction to all who are interested in the possible application of the fluidization technique to industrial processing operations.

L. S. T.

Automation : Its Purpose and Future. Magnus Pyke. London : Hutchinson's Scientific & Technical Publications, 1956. Pp. 191. 16*s*.

Dr Pyke first reviews what has already been done in the field of automatic operation and then describes briefly the principles and development of the digital computer. Succeeding chapters discuss the application of " automation " to various industries, including the petroleum and the chemical industries. He points out that the petroleum industry has always used a high proportion of automatic equipment, and is of the opinion that, in considering the impact of " automation " on our lives, the way in which petroleum is handled is of particular significance. He suggests that it only needs rapid automatic methods for analysing samples to enable the petroleum business to be run by a digital computer.

Oil in Uganda. N. Harris, J. W. Pallister, and J. M. Brown. Geological Survey of Uganda Memoir No. IX. Entebbe : Govt Printer, 1956. Pp. 33 and 6 insets. Shs. 12/50.

The last account of oil exploration in Uganda was Memoir No. I by E. J. Wayland, published in 1925. Since then a considerable amount of Government and commercial exploration has been made, and the present memoir is an up-to-date record of these investigations.

Safety with Solvents. H. B. Humphrey and G. Morgis. Bureau of Mines Information Circular 7757, U.S. Dept. of the Interior, Aug 1956. Pp. 25.

The increasing use of solvents in industry today has shown the dangers that exist unless safety precautions are stringently applied. This publication lists the main types of solvent, together with their chief hazards, and gives counteracting safety measures. The 8½-page appendix provides at-a-glance information on flash points, explosive limits, auto-ignition temperatures, specific gravities, and vapour densities.

Review of Benzole Technology 1955. London : The National Benzole and Allied Products Association, 1957. Pp. 113. 21*s*. 9*d*. post free.

The NBA, as sponsors of this third volume of the published series on benzole technology, and the technical staff of the National Benzole Company Ltd., who carried out the work which enabled it to be published, have again performed a considerable service to the benzole and associated industries.

In collating and summarizing the data published during 1955 relating to this industry, over one thousand original articles have been consulted. The layout follows the general lines of the preceding volumes.

Design of Piping Systems. 2nd Edition. The M. W. Kellogg Company. New York : John Wiley and Sons Inc.; London : Chapman and Hall, 1956. Pp. 365.

This second edition of a book originally published privately by the M. W. Kellogg Company in 1941 has been considerably extended in comparison with its predecessor and made generally available. The nine chapters cover strength and failure of materials, design assumptions, local components, flexibility analysis, general analytical method, model test, expansion effects, support, and vibration, while the three appendixes incorporate formulæ, charts, and tables.

Petroleum Facts and Figures. 12th Edition. New York : American Petroleum Institute, 1956. Pp. 390.

Whatever statistical facts are required about the U.S. petroleum industry can be answered from this book, which is in general up-to-date to 1955, although in a few cases 1954 is the last year given. With the ninth edition (1950) the statistical record is complete as far as information is available. It is authoritative.

Some world data is given, and a list of sources of statistics adds to the value of the book.

British Standards :

B.S. 84 : 1956. Parallel Screw Threads of Whitworth Form. Pp. 66. 10*s*. net, post free.

B.S. 2773 : 1956. Domestic Space Heaters for Use with Butane/Propane Gases. Part I : Space Heaters for Use with Butane Gas. Pp. 21. 6*s*. net, post free.

This specification is intended to establish minimum standards for construction, performance, and safety requirements for domestic space heaters burning butane gas. The three sections are headed General, Construction, and Operation, there are two appendixes giving B.S. injector jet numbers and the temperature of surfaces of pre-cast flues, and there are 11 diagrams.

B.S. 2806 : 1956. Limiting Dimensions of Air Filters for Internal Combustion Engines and Compressors other than for Aircraft. Pp. 14. 3*s*. 6*d*. net, post free.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

020 DUNSHEATH, P. *ed.* Industrial research 1956–1957. London, Todd, 1956. 444 p.

020 INSTITUTION OF MECHANICAL ENGINEERS. Brief subject and author index of papers in the Proceedings 1937–1954. London, I.Mech.E., 1955. 130 p.

020 WORLD OF LEARNING 1956. 7th ed. London, Europa, 1956. 1079 p.

040 ASLIB. British scientific and technical books: a select list of recommended books published in Great Britain and the Commonwealth in the years 1935 to 1952. London, Clarke for ASLIB, 1956. 375 p.

080 SKINNER, W. E. *comp.* Oil and petroleum year book 1956. London, Skinner, 1956. 520 p.

090 BRITISH IRON AND STEEL RESEARCH ASSOCIATION. Paints for structural steelwork. London, BISRA, 1955. 43 p.

220 PETROCO. Impurities in petroleum: occurrence, analysis, significance to refiners. Long Beach, Calif., Petroco, 1955.

270 AMERICAN SOCIETY FOR TESTING MATERIALS. ASTM standards on engine antifreezes: methods of testing, specifications. Philadelphia, Pa., ASTM, 1956. 55 p.

270 AMERICAN SOCIETY FOR TESTING MATERIALS. 1956 supplement to book of ASTM standards including tentatives. Part 2. Non-ferrous metals. Philadelphia, Pa., ASTM, 1956. 346 p.

270 AMERICAN SOCIETY FOR TESTING MATERIALS. 1956 supplement to book of ASTM standards including tentatives. Part 7. Textiles, soap, water, paper, adhesives, shipping containers, atmospheric analysis. Philadelphia, Pa., ASTM, 1956. 213 p.

360 SOCIETY OF EXPLORATION GEOPHYSICISTS. Geophysical case histories. Vol. 2—1956: a collection of 53 papers by 75 authors, edited by P. L. Lyons. Tulsa, Okla., SEG, 1956. 690 p. Assembled from papers published by the Society of Exploration Geophysicists and the American Association of Petroleum Geologists, together with mostly new material. This volume supplements Volume 1, published in 1948.

710 KELLOGG COMPANY, THE M. W. Daura refinery. New York, Kellogg, n.d. 10 p.

730 MONSANTO CHEMICAL COMPANY. Pipelines to the future: a study of plastic pipe. Springfield, Mass., Monsanto, 1955. 64 p. (Monsanto business executive series no. 3.)

740 PYKE, M. Automation: its purpose and future. London, Hutchinson, 1956. 191 p.

790 UNITED STATES. BUREAU OF MINES. Synthetic liquid fuels: annual report of the Secretary of the Interior for 1955. Part 1—Oil from coal. Washington, D.C., U.S. Dept. Interior, 1956. 53 p. (Report of investigations 5236.)

810 HENLY, A. T. Oil fuel applications. London, Crosby Lockwood, 1956. 259 p.

810 TRINKS, W. Industrial furnaces. Vol. 2. 3rd ed. New York, Wiley, London, Chapman and Hall, 1955. 368 p.

810 UNITED STATES. BUREAU OF MINES. National survey of burner fuel oils, 1956, by O. C. Blade. Washington, D.C., U.S. Dept. Interior, 1956. 24 p. (Information circular 7762.)

830 BARWELL, F. T. Lubrication of bearings. London, Butterworths, 1956. 304 p.

830 FULLER, D. D. Theory and practice of lubrication for engineers. New York, Wiley, London, Chapman and Hall, 1956. 435 p.

860 ONG, E. R. DE. Chemistry and uses of pesticides. 2nd ed. New York, Reinhold, London, Chapman and Hall, 1956. 341 p. Title of 1st ed.—"Chemistry and use of insecticides."

870 SHELL OIL COMPANY OF CANADA. *Chemical Division.* The Canadian petrochemical industry. Toronto, Ryerson, 1956. 165 p.

880 COMMITTEE ON SYNTHETIC DETERGENTS. Report of the Committee on synthetic detergents. London, HMSO, 1956. 60 p.

890 ESSO PETROLEUM CO. LTD. Enjay butyl: a general purpose synthetic rubber, by E. Arundale and J. P. Haworth. London, Esso, 1956? 16 p.+

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

408. Time accumulation and evolution of hydrocarbons. W. C. Gussow. *World Oil*, 1956, **143** (4), 113.—Factors to be considered in determining the time of formation of an oil accumulation are briefly discussed. The age of the structure, rather than the age of the reservoir rock, saturation pressure, segregation of fluids by differential entrapment, and the evolution of cyclic hydrocarbons must all be considered, together with an analysis of the historical geology of the area, including cementation, development of secondary porosity, and development of unconformities. C. A. F.

409. Migration of oil. W. C. Gussow. *World Oil*, 1956, **143** (2), 79.—Fundamental principles of primary and secondary oil migration are briefly discussed, and evidence for secondary migration is summarized. Primary migration is believed to be controlled by compaction and capillary displacement

pressures, but no widespread secondary migration occurs until the beds have been tilted. After tilting, oil movement is normal to contour lines and oil accumulates in "culminations." The concept of differential entrapment shows that eventually gas collects in down-dip traps whilst oil is flushed into successive up-dip traps. Up-dip limits of gas flushing are important in evaluating oil possibilities of a basin, and examples are given. One ref. C. A. F.

410. Fossil subterranean oceans and oil. W. Bruderer. *Bull. Ass. franç. Tech. Pétrole*, Nov 1956, (120), 535–56.—Consideration of the large volumes of salt water present in porous and permeable rocks which can act as oil reservoir rocks has led to the hypothesis that on many occasions such water has entered these rocks where exposed as the seas invaded the area after a period of unconformity. The invading water filled up the pores or displaced such water as existed in the pores at the time of transgression. Sometimes the invading water would have entrained organic matter, which by biochemical or other means would be transformed later into petroleum. The preservation of this petroleum required saline waters or considerable amounts of H_2S. According to this hypothesis there would be no source rock of the conventional type, but the oil would be generated in the reservoir rock.

These ideas have emerged from consideration of oil accumulations trapped at unconformities, such as E. Texas. The age of the oil would be essentially that of the transgression. In some cases, and excluding vertical migration across the strata, the oil could be considerably younger than the caprocks, *i.e.* for traps away from the unconformity.

Fossil saline waters are classified as protogenetic, autochthonous, and catastrophic, the last group being emplaced during transgressions. Catastrophic waters charged with organic matter could bring oil to ancient basins which were initially sterile.

5 examples are considered in illustration of the hypothesis, involving transgression on a folded foreland, on a porous limestone platform, on a coastal zone with alluvial cones, on a continental basin with fresh water in the rocks, and on a complex foreland zone. G. D. H.

411. Gyratory sieving speeds research. R. H. Cummings. *World Oil*, 1956, **143** (5), 137.—The applications of the sieving unit which provides gyrating and vibratory motion in screening are briefly described. The main uses are for separation of minerals in sediments, grain size analysis, and concentration of fauna in micropalæontology. In dry sieving the disintegrated material is oven-dried before screening, whereas in wet screening a continuous jet of water is played on to the top sieve. Wet screening accelerates the screening process, and the use of a lubricant (such as soap) in the jet provides a cushioning medium and helps to preserve delicate fossils. C. A. F.

412. Clay minerals as influenced by environments of their formation. W. D. Keller. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2689–710.—The clay minerals show a wide range in chemical composition and offer some potential information as mineral indicators of the environments of their formation.

In this paper, the potentiality of clay minerals as useful indicators of the environment of their formation is summarized from the published literature on the origin of clay minerals. Caution must be observed when drawing geologic inferences from a rock or mineral concerning its origin, because the rock or mineral may not have been formed where it now is found. Clay minerals are products of parent materials responding to the energy present in the reaction under which they were formed. In the genesis of some minerals the effect of parent material is dominant; in others the controlling factor is environment. E. N. T.

413. Factors in lithostratigraphy. H. E. Wheeler and V. S. Mallory. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2711–23.—American stratigraphers are now in general agreement that litho-, bio-, and chrono-stratigraphic units differ distinctly in both concept and fact. Unfortunately there is little general agreement on the nature or extent of these conceptual or factual differences. With the hope of stimulating both thought and discussion the writers pursue here an examination of some of the factors involved in a flexible yet workable lithostratigraphic classification. E. N. T.

414. Use of quantitative fluorescence measurements in drilling operations. H. Zierfuss and D. J. Coumou. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2724–34.—Examination in u.v. light is known to be a sensitive method for the detection of oil in drilling mud, cuttings, or their extracts.

The use of a fluorimeter with which the intensity of the fluorescence can be measured permits a relative determination of the oil content of samples. The procedure is described.

A method in which fluorimetry is adapted to the problem of differentiating oil showings in drilling wells is also discussed. In the procedure suggested the intensities of fluorescence of an extract in various dilutions are measured until a max is observed. This max appears to be characteristic for the oil. Some examples of applications are given. E. N. T.

415. Salt dome interest centres on Gulf Coast. J. B. Eby. *World Oil*, 1956, **143** (5), 143.—The world distribution of salt beds and domes is outlined, with emphasis on the salt dome area of the Gulf Coast. Regional maps are included. C. A. F.

416. Shell, Humble hit offshore. Anon. *Oil Gas J.*, 29.10.56, **54** (78), 71.—A well drilled in 67 ft of water *ca* 40 miles offshore from the Louisiana coast has discovered a new field *ca* 70 miles S. of Morgan City. On test the well produced 378 b.d. of 35·9° clean oil and 182,000 cu. ft. gas/day. Total depth was 11,691 ft. The well is 20 miles SE. of the Block 128 field, where there are several producing wells. C. A. F.

417. Future of Louisiana offshore oil province. G. I. Atwater. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2624–34.—The continental shelf of the Gulf of Mexico constitutes America's newest oil province because of its geographic position and the special operating conditions that prevail in the area; it has already become a major oil- and gas-producing area at this early stage in its development. The most important part of this new oil province is now established as those water bottoms lying offshore of S. Louisiana, and it is in this area that current leasing and drilling activity are greatest.

A detailed study has been made of all of the major structural features in the prolific Miocene producing trend of S. Louisiana in order to predict the future of its offshore counterpart. These features have been classified as piercement-type salt domes and deep-seated structures, and the oil and gas reserves and drilling success ratios for each type have been established. The study has been restricted to the major structural features, commonly referred to as grade "A" prospects, as the initial offshore exploration programme will be restricted to such structures.

It is predicted that one out of 4 of 95 major offshore structures will be proved commercially submarginal. However, one out of 5 of the major offshore structures should contain a giant field with reserves in excess of 100 million brl of oil or its equivalent, or both. These giant fields will account for more than 50% of the total reserve of the above marginal fields. E. N. T.

418. Marginal sediments of Mississippi delta. F. P. Shepard. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2537–623.—To

obtain a better grasp of the litho-facies and bio-facies of the delta-to-marine transition, a study has been made of the sedimentary environments bordering the E., actively-growing distributaries of the Mississippi birdfoot delta. Approx 1000 samples, mostly cores, were obtained from the distributary mouths, the continental shelf to the E. of the delta, the continental slope to depths of 550 ft, and Breton Sound with its bordering Breton and Gosier islands. For comparative purposes samples have also been obtained in the vicinity of S. and SW. passes. The present paper discusses primarily the characteristics of the surface sediment, leaving for a future report a discussion of a relatively shallow third-dimensional phase of the study which is not yet complete.
E. N. T.

419. North Texas—land of independents. N. S. Morrisey. *Oil Gas J.*, 5.11.56, **54** (79), 91.—The oil geology of N. Texas is briefly described. Pay zones are numerous and shallow, and the most important are the Cisco sands, Canyon sands and limestones, Strawn sands, Caddo limestones and conglomerates, and the Mississippian limestone. Seismic work has given satisfactory results in some areas.

Prospects for finding new fields are good, and deep reservoirs may be important in the future. Wedge belts of porosity and stratigraphic traps in the pre-Permian carbonate rocks are envisaged.

Tables show recent discoveries, estimated ultimate recoveries from some Caddo fields, and Mississippian fields. C. A. F.

420. The Reinecke field . . . six years later. R. L. Redline. *Petrol. Engr*, 1956, **28** (5), B99.—The Reinecke field in Borden County, Texas, was discovered in 1950, and it now comprises some 2800 productive acres supporting 69 wells. Pay is Pennsylvanian Cisco limestone, which is developed as a reef consisting of vugular and fractured limestone and dolomite. Max thickness of the reservoir rock is *ca* 300 ft. Original bottom hole pressure was 3167 p.s.i. at 4400 ft subsea, and from Feb 1950 to Jan 1956 this fell to 2324 p.s.i. with a production of 13,061,395 brl. Original reserves were estimated at approx 111 million brl. Representative logs and structure diagrams of the field are included. C. A. F.

421. New York discovery being developed. H. T. Brundage. *World Oil*, 1956, **143** (5), 110.—4 producers have been completed in a new field in Cattaraugus County, W. New York, which was found in 1955. Production is gas and dist from the top of the Oriskany sand at *ca* 3700 ft, and the accumulation is believed to be a stratigraphic trap with NW. pinch-out of the Oriskany. Most Oriskany gas found hitherto has been very dry, and the " wet " accumulations seem to be generally limited to the stratigraphic accumulations. Deep Oriskany production in structural traps is very lean or almost dry gas.
C. A. F.

422. Subdivision of Pottsville formation in Southern anthracite field, Pennsylvania. G. H. Wood, Jr., J. P. Trexler, H. H. Arndt, A. Yelenosky, and J. Soren. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2669–88.—The Pottsville formation is the basal Pennsylvanian unit in the anthracite fields of Pennsylvania. It is underlain by the Mauch Chunk formation of Mississippian age and is overlain by the later Pennsylvanian Buck Mountain or twin coal bed. The Pottsville consists of a sequence of conglomerate, conglomeratic sandstone, siltstone, shale, and coal beds that is as much as 1200 ft thick in places.

The present authors redescribe the Pottsville formation, and member status is proposed for the 3 lithologic units which are here named, from the base up, the Tumbling Run member, Schuylkill member, and Sharp Mountain member. The 3 members are composed largely of pebble and cobble conglomerate, fine conglomerate, conglomeratic sandstone, and sandstone, with subordinate quantities of shale, siltstone, and coal. They have been mapped in detail throughout much of the central and W. parts of the S. anthracite field. The members have also been tentatively correlated into the central and E. parts of the W. Middle anthracite field and the E. Middle anthracite field. The upper member has been tentatively correlated into the N. anthracite field. E. N. T.

423. The Simpson group along east flank of the Anadarko basin. R. W. Disney and C. E. Cronenwett. *World Oil*, 1956, **143** (4), 118.—The stratigraphy of the Simpson formation in Oklahoma is described in detail. The beds thin generally northwards due to basal onlap, intraformational thinning, and top truncation. Pure quartz sandstones are abundant and persistent, indicating a continuing source and possibly reworking of lower Simpson beds. There is evidence of wind action in some sands. It is concluded that over much of Oklahoma the formation represents a nearly stable shelf deposit. A geosynclinal facies is not indicated, and it is thought that the present structural basins in the area were not sufficiently developed in Simpson time to have affected Simpson sedimentation appreciably. 15 refs. C. A. F.

424. Tilted fluid contacts in Mid-Continent region. W. L. Russell. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2644–68.—Tilted fluid contacts are of greater importance than their relative scarcity suggests. If the origin of these features could be determined, some baffling problems of petroleum geology might be solved. In particular, light might be thrown on the movements of the water associated with oil and gas, and on the way in which oil and gas migrate.

In this paper, the author gives equations for tilted fluid contacts tilted by moving oil with stationary water. The equations describe the relations between the angle of tilt, the horizontal gradients in head or pressure, the speed of flow, the permeability, and the visc. The equations may be used to analyse the field data to determine the cause of the tilts in given cases. Although some lab data suggest that capillary phenomena may produce tilted or irregular contacts, the field data suggest that the effect of variations in pore size is in most cases unimportant. However, in some fields, such as Wasson, W. Texas, capillary relations may cause the tilts of the oil–water contacts. Some tilted contacts appear to be produced by structural tilting of level contacts which have been sealed or made immobile by chemical reactions that produce solids.
E. N. T.

425. Sedimentary basins in Oregon. R. E. Corcoran. *World Oil*, 1956, **143** (5), 141.—Recent exploration in Oregon has centred in the Tertiary marine basin of W. Oregon, the Tertiary continental area of the Snake River along the border of Idaho, and in the Palæozoic–Mesozoic area of Central Oregon. Drilling has been sparse, and most of these wells were less than 3000 ft. Greatest activity has been in the Snake River and Tertiary basins. Recent work has included core drilling, geophysical prospecting, and surface work. 10 refs. C. A. F.

426. New and redefined Cretaceous formations in Western part of Northern Alaska. E. G. Sable. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (11), 2635–43.—As a result of recent mapping, some of it by the U.S. Geological Survey in co-operation with the U.S. Navy's petroleum investigation programme, the sequence of Mesozoic rocks in the Colville River region of N. Alaska has been redefined. The Nanushuk group is redefined in the Utukok–Corwin area, where the group consists of 2 formations, the Kukpowruk (new) and the Corwin (redefined). The dominantly marine Kukpowruk formation consists largely of shale, siltstone, and sandstone; it overlies and intertongues with the upper part of the Torok formation. The Corwin formation is dominantly non-marine, and consists largely of shale, siltstone, sandstone, conglomerate, and coral; it overlies and intertongues with the

upper part of the Kukpowruk formation, and is overlain by the Prince Creek formation of the Colville group. E. N. T.

427. Yemen, Arabian exploration activities accelerate. Anon. *Petrol. Engr*, 1956, **28** (9), B133.—Exploration work has been carried out in the Yemen, S. of Saudi Arabia, by several companies.

Kharsaniya 1, *ca* 80 miles NW. of Dhahran on the coast of the Persian Gulf, on test of the Arab Zone at *ca* 5900 ft flowed at 2200 b.d. of 32°–33° oil.

An underwater well is to be drilled *ca* 20 miles from Das, an island 60 miles from the Persian Gulf coast in the Abu Dhabi area. C. A. F.

428. Japan goes offshore. Anon. *Oil Gas J.*, 5.11.56, **54** (79), 83.—4 structures shown by geophysical surveys are to be tested by drilling in an offshore area which extends for 36 miles from Tsuchizaki to Hirasawa in Akita, Japan. Tsuchizaki is near the Yabase field, which produces 3750 b.d., over ½ of the total production of Japan. The structures are said to be in Tertiary beds *ca* 2½ miles offshore.

Exploratory work is being carried out in Hokkaido and elsewhere. C. A. F.

429. Use of granulometric methods in interpreting a detrital series; study of sedimentation between Granville and Chausey. J. Debyser and C. Fondeur. *Rev. Inst. franç. Pétrole*, 1956, **11** (5), 551–72.—A series of deposits consisting of sands, gravels, and pebbles from the zone between Granville and Chausey Isles have been studied. The samples were obtained from boreholes. The size distribution in these samples has been determined. In addition, acid treatment was used to determine the content of $CaCO_3$, and the fossil content of limestone pebbles was studied. The methods proposed by Doeglas were applied to investigate the make-up of the deposit, and evidence emerged that there were 2 sources of material which by admixture in different amounts accounted for the observed size distributions. One type of material apparently came from the Chausey Isles and the other from the dunes along the coast near Granville.

The heavy mineral suite coming from the fraction finer than 400 μ was similar in all samples, and seemingly comes from the dune sands.

Various organic remains were observed, but these were erratic in distribution.

Granulometric methods of study should be applied flexibly, and size ranges used selected to suit the material under study. G. D. H.

430. French well tested. Anon. *Oil Gas J.*, 5.11.56, **54** (79), 83.—Lucats 1, *ca* 4½ miles SE. of the Parentis field discovery in SW. France, on test produced *ca* 30 b.d. of 37° oil from limestone zones between 6704 and 6917 ft.

Parentis oil is *ca* 32° gravity. C. A. F.

431. ARPE completes two gas wells on Mt Etna flanks. H. T. Brundage. *World Oil*, 1956, **143** (2), 168.—2 gas wells have recently been completed on the S. and W. flanks of Mt Etna in Sicily, and a third well is being drilled. At Catania, S. of Mt Etna, an established gas field is producing 5·3 M.m.c.f/day from 8 wells from Miocene or Pliocene sands ranging from 1950 to 2650 ft. One of the recent discoveries found gas below lava in Eocene sand at *ca* 3900 ft, and the other, 8 miles W. of Catania, found gas in a thin Tertiary sand at *ca* 2670 ft. A map showing locations of recent wells and established fields in Sicily is included. C. A. F.

DRILLING

432. Power transmission. A. B. Fredhold. *Petrol. Engr*, 1956, **28** (9), B28.—In drilling, power is required for hoisting, rotating, pumping, and service auxiliaries, and this is transmitted from the source engine by various means. The design of a power transmitting system compromises between conflicting requirements, *e.g.* heavy duty design requires weight and rigidity, whereas current drilling operations require in general quick and simple portability.

Various methods and arrangements of power transmission in drilling are described, such as compounding transmission, hydraulic couplings, convertor–coupling combination, electromagnetic drive-electric coupling, and types of clutches. Basic means of transmission are chains, V-belts, and gears. In recent years diesel electric transmission has become more important, as the power source can be located at some convenient distance from the rig. Their main application has therefore been in offshore drilling. Photographs and drawings of transmission equipment are included. C. A. F.

433. Corrosion protection of oil well casing. W. C. Koger. *Petrol. Engr*, 1956, **28** (9), B64.—The reasons for protecting casing against corrosion, the causes of corrosion, and methods for detecting and combating it are discussed. Corrosion in casing is either internal or external; the former can be prevented by introducing volatile inhibitors or hydrocarbons into the annulus. External corrosion, whose cause may be difficult to find, can be combated by cathodic protection, or by using protective methods when the casing is set. These methods include cementing a long string of surface pipe to the surface, cementing the oil string to the surface, cementing the oil string through the corrosive zone using a stage cementing collar, isolating the casing from a corrosive formation with organic or inorganic gel-type materials, and using a high pH mud. 8 refs. C. A. F.

434. Continuous velocity log. E. M. Denton. *Oil Gas J.*, 19.11.56, **54** (81), 224.—Continuous velocity logs have proved useful not only in identifying reflections and seismic depth determinations, but also for identifying and correlating lithological boundaries between wells. Recently, a study of these logs from Canada has shown that they can also be used for determining porosities and detecting hydrocarbons.

The velocity curve can be related to lithology by the equation:

$$V_L = \left[\left(K + \frac{4}{3}n\right)/e\right]^{\frac{1}{2}}$$
$$= (\text{Elasticity}/\text{Density})^{\frac{1}{2}}$$

where V_L = longitudinal acoustic velocity, K = bulk modulus of elasticity, n = shear modulus of elasticity, and e = density.

In sediments higher densities are usually due to compaction, resulting in an increase in elasticity, so that changes in the log reflect changes in the elasticity of the beds. An empirical relationship between velocity and porosity has been determined in limestones using available core data, and a quasi-linear curve resulted. In any bed of fairly constant composition and porosity the velocity on the log remains constant if the fluid saturating the bed is the same type throughout, but if hydrocarbons (which have low velocities) replace the water, a decrease in velocity is shown on the log. Examples of this are given. It is emphasized that there is a considerable field of research in the application of velocity logs to formation evaluation. 6 refs. C. A. F.

435. Drill stem testing in high-angle directional wells. C. C. Liedholm. *Oil Gas J.*, 5.11.56, **54** (79), 113.—Drilling and completing high drift-angle directional wells have been routine operations in several areas along the California coast, and it has been necessary to develop a method of formation testing in holes with inclinations of over 70° from vertical. This has been successful, using conventional testing tools. 90 ft of drill collars are used to give sufficient weight to actuate the packers, as only *ca* 30% of the weight of the normal string is effective down-hole with a drift angle of *ca* 70°. C. A. F.

436. Radioactive tracer techniques. G. L. Gore and L. L. Terry. *J. Petrol. Tech.*, 1956, **8** (9), 12–17.—γ-Ray logging of the formations was first used in the early 1940s. Radioactive tracers, one of the most popular being Iodine-131, have been used for various purposes. Iodine-131 emits highly penetrating γ-rays, and can be incorporated in water-, acid-, and oil-soluble cpds. In lost circulation surveys, after a preliminary γ-ray survey the tracer is spotted at intervals in the well fluid column and logged. After small known displacement of the well fluid a further log records the movement of the tracer patches. If the movements do not correspond with the known displacement lost circulation zones have been covered and further injection and surveys permit their more precise location.

The top of cement can be located by incorporating tracers, and the soundness of cement jobs can sometimes be detected by injecting through the perforations tagged water, oil, or acid. In selective acidizing, acid is pumped down the tubing and oil down the annulus, or vice versa, depending on whether the zone to be protected is below or above that to be acidized. A tracer in one of the fluids allows the fluid interface to be detected; with a tracer in the acid the zones taking acid best can also be detected. For a variety of reasons checking fracture treatment may not be especially effective. A shielded scintillation counter with a rotating window may, however, succeed in indicating the presence of vertical fractures, as distinct from horizontal.

Leaks in tubing and casing can be detected, permeability surveys can be made, and other operations carried out by suitable adaptations. G. D. H.

437. Operation muskeg. W. Booth and A. S. Murray. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 94–7.—The specialized winterization methods and drilling operations required in the muskeg country of Canada are discussed. Preparing the location, moving in, rigging up, drilling the well, and completion or abandonment work are covered. Development costs are compared with costs in plains areas.

(Authors' abstract.)

PRODUCTION

438. Conditioning of Pacific Ocean water for water flood injection. J. D. Sudbury, C. F. Knutson, M. Felsenthal, and J. D. Lung. *J. Petrol. Tech.*, 1956, **8** (9), 85–9.—When the Third Grubb zone at Ventura, California, was to be flooded the question of using sea water arose. Permeability studies were made on cores, and it was found that stable sterile water caused no plugging with prolonged flow, unstable sterile water caused a gradual drop in permeability, unstable non-sterile water led to an immediate and drastic drop, while stable non-sterile water caused a marked drop after a time. In each case the water had been filtered through ultra-fine fritted glass. The ocean water appeared to be compatible with the formation water, and the 2 analyses did not differ markedly except in sulphate and bicarbonate contents. Filtered and stabilized ocean water showed bacteria and plankton, and these materials were thought to contribute to plugging, as was the development of iron hydroxide, sulphide, and calcium carbonate. At the reservoir temp of 200° F carbonate deposition was severe.

The treating system devised used a sand filter, a diatomaceous earth filter to remove all suspended matter, 7·5 p.p.m. of ammonium chloride to kill bacteria (this also served as a corrosion inhibitor), gaseous SO_2 (*ca* 28 lb/1000 brl) to reduce the pH from 7·8 to 5·4. The pilot plant collected sea water from beneath the beach sand at up to 2000 b.d. Unit design permitted possible expansion to 10,000 b.d. Automatic controls were fitted, and provision made for various routine tests, and these tests are discussed, together with the layout of the water system. The field pilot studies showed the treating system to meet the requirements. G. D. H.

439. Evaluation of water flood prospects. P. J. Shanor. *World Oil*, 1956, **143** (4), 174.—3 factors must be considered in evaluating an area for water flood prospects: the extent of the reservoir, the recoverable secondary oil reserves, and economic problems. There are, however, additional controversial factors which are difficult to evaluate, but a pilot project may often solve many problems before the main development of the secondary project. A table shows the various reservoir characteristics, production data, fluid characteristics, and economic factors which are determined in evaluating the probable success of a future project.

C. A. F.

440. Water flood operations in the North Meadow Creek Sussex sand unit. L. B. Myers. *J. Petrol. Tech.*, 1956, **8** (9), 27–32.—The North Meadow Creek field, opened in Dec 1949, had 41 wells drilled on 20-acre spacing by Oct 1950. 6 further wells were drilled in developing the Sussex sand, which dips at *ca* 3°–6° and has 300 ft of closure above the oil–water contact. Peak production was 4000 b.d., and then decline set in at *ca* 45%/year in 1951. The oil sand averages 24 ft in thickness, and totals 22,285 acre-ft. Original stock-tank oil was 22,396,000 brl, and primary recovery was predicted as 15·1%. A pilot water flood was started in Dec 1953, after preliminary studies had shown that bentonitic matter in the sands would swell on contact with fresh water, but that 700 p.s.i.g. at the surface should allow 200 b.d./well water injection. The first 4 injection wells averaged 250 b.d. each, with no surface pressure until 144,000 brl had been injected, and then 2 wells required surface pressures of 200 p.s.i.g. At this time the well at the centre of the injection wells began to show increased oil output. Later its gas–oil ratio fell and its oil output attained 250 b.d. (145 b.d. more than its peak primary output) of which 236 b.d. was attributed to water injection.

In July 1956, daily output was 1700 b.d., or 1510 b.d. more than predicted primary output. There were then 18 input wells, 3 having been specially drilled. A new water source well had been brought into operation, but this led to trouble from bacterial slimes until chemical control was introduced.

To July 1956, 2,566,000 brl of water had been injected, and the average rates of injection were then 450 b.d./well, at 375 p.s.i. surface pressure. Ultimate recovery is expected to be increased by 250 brl/acre-ft as a result of flooding.

G. D. H.

441. Mobility ratio—its influence on injection or production histories in five-spot water flood. J. S. Aronofsky and H. J. Ramey. *J. Petrol. Tech.*, 1956, **8** (9), AIMME Tech. Paper No. 4339, 205–10.—Potentiometric studies have been made to find the effect of mobility ratio on injection and production history for a 5-spot water flood. Plots are given of areal sweep efficiency against mobility ratio for these and various other studies, and these show a steep decline in sweep efficiency with increasing mobility ratio at low values of the latter. Further plots show the nose advance ratio against the conductance ratio, based on the potentiometric studies, for various mobility ratios. The conductance ratio is the production rate/unit pressure drop for a specified mobility ratio divided by the production rate/unit pressure drop for unit mobility ratio when the mobility is specified. The nose advance/conductance plots are affected by the ratio of the well spacing to the well radius, and it is concluded that this ratio may be of importance in practice. G. D. H.

442. Mechanism of water flooding in the presence of free gas. J. R. Kyte, R. J. Stanclift, S. C. Stephan, and L. A. Rapoport, *J. Petrol. Tech.*, 1956, **8** (9), AIMME Tech. Paper No. 4341, 215–21.—The experiments were made on natural and arti-

ficial cores 2–18 inches long, 1·46–3·41 inches dia, and of permeability 87–640 mD. Some were water-wet, others oil-wet. The mean pressure was *ca* 1100 p.s.i., and the flooding pressure differential *ca* 50 p.s.i., while the oils had visc of 1·4, 22, and 116 cP at 76° F. Helium was the gas phase. In the reference floods there was no free gas; the others had mobile or trapped gas phases. High flood rates were used to minimize capillary end effects.

With a mobile gas phase, water-flooding appears to give an oil bank followed by a water bank. In the presence of a gas phase the residual oil saturations obtained by water floods were appreciably lower than in the absence of gas. For a given porous medium and fluid system there is a unique relationship between the trapped gas saturation and the initial mobile gas saturation; the oil saturation attainable at any one flooding stage and the trapped gas saturation; the oil saturation attainable at any one flooding stage and the initial mobile gas saturation. Gas compressibility and solubility were assumed to have negligible effects on the studies.

It is proposed that short cores with 2 phases should be used to obtain data on the relationships between mobile and trapped gas, and between trapped gas saturations and residual oil saturations. Combination of these 2 sets of data allows correlation of the residual oil saturation with the mobile gas saturation at the start of the water flood.

In practice water floods are seldom carried beyond a total water injection of 1–2 pore volumes. G. D. H.

443. The future of water flooding in the U.S. A. E. Sweeney. *Petrol. Engr.*, 1956, **28** (5), B77.—During the past 4 years annual production from water flooding operations in the U.S.A. has increased from 80 million brl to approx 130 million brl, and it is predicted that a max annual peak for production from this source will be 750 million brl in 1980. Future trends in water flood production are discussed, and it is shown that the main increase will come from Texas, Louisiana, California, Illinois, and Oklahoma. 2 refs.
C. A. F.

444. Proposed offshore production and gathering facilities, Eugene Island area, Louisiana Gulf of Mexico. R. H. Illingworth, W. L. Montgomery, C. Aldridge, and C. V. Temple. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 74–89.—The authors present some of the major problems encountered in the design and layout of a proposed offshore system of production, and gathering facilities which are now under construction are expected to be completed and in operation in Aug 1955. The high cost of barging, delay caused by the weather, which has run as high as 25%, and the overall high cost of offshore operations necessitated considering some means of minimizing the difficulties of producing oil offshore. After numerous studies and consultations, the proposed project was decided upon. (Authors' abstract.)

445. Review and appraisal of offshore operations. I. H. Cram. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 90–3.—In spite of obstacles, the petroleum industry has spent $650 million in offshore operations off Louisiana and Texas. Gross revenue from all of the oil and gas sold from this area is estimated at $110 million. At the present time, the explorer is rich in structural information and poor in stratigraphic information. Through the drilling of wildcat wells, the explorer will gradually acquire stratigraphic knowledge, and trends of maximum and minimum reservoir rock development will emerge. He will then be in a better position to appraise the economic value of his structural information.
(Author's abstract.)

446. Formation evaluation of some limestone reservoirs with particular reference to well logging techniques. E. E. Finklea. *J. Petrol. Tech.*, 1956, **8** (8), 25–31.—4 representative limestone reservoirs of Permian, Pennsylvanian, Mississippian, and Devonian age, are discussed in order to illustrate various methods of evaluation, and to draw attention to their limitations. Where practicable a good description of the formation should be used in conjunction with the logs. These descriptions may afford data on limiting values of porosity and saturation for a given formation, which serve as partial checks of values derived from logs. The limitations of logs and their interpretations should be understood before logs are evaluated, and these limitations should be kept constantly in mind in dealing with the difficult problem of evaluating limestone reservoirs. G. D. H.

447. Selecting a well completion programme. J. A. Le Velle. *Petrol. Engr*, 1956, **28** (5), B38.—Factors to be considered in selecting a well completion programme and the equipment necessary are discussed. The method used depends mainly on formation characteristics, future workovers, and anticipated well requirements. Methods of completion are shown in a series of diagrams, together with notes on the advantages of each. During the producing life of the well the completion may be modified several times to meet production requirements. 14 refs. C. A. F.

448. Modified multiple-well completion. B. L. Crain and B. G. Taylor. *Petrol. Engr*, 1956, **28** (5), B91.—A method of well completion is described in which gas from a middle zone lifts oil from an upper zone whilst a third bottom zone produces oil straight through tubing. This triple completion was made in the NE. Purdy field, Oklahoma, where there are 3 sand pays, the Springer sand (oil), the Lower Hart (gas), and the Upper Hart (oil). Diagrams show the tubing string assembly and the cross-over assemblies required to permit gas from the middle zone to lift the oil in the top zone.
C. A. F.

449. World's deepest well now deepest producer. Anon. *Petrol. Engr*, 1956, **28** (5), B48.—A wildcat 35 miles S. of New Orleans in the Lake Washington area has been completed for production from 21,443–21,465 ft. The well is flowing 38° oil, and if maintained it will become the world's deepest commercial producer. It is the deepest well, with a total depth of 22,570 ft. Costs are reported to be over $2,400,000.
C. A. F.

450. Demulsification of crude oils. C. Labbe. *Rev. Inst. franc. Pétrole*, 1956, **11** (5), 584–98.—The breakdown of emulsions of crude oil and water can be achieved chemically by the use of anionic, cationic, and non-ionic cpds. The last type has advantages in that the cpds can be changed in their affinity for oil or water by progressively altering their composition. The emulsions are usually water-in-oil, and the breakdown of these is aided by chemicals which have affinity for water, provided that the amount used is not sufficient to reverse the emulsion to oil-in-water.

The demulsifying agents studied in detail were non-ionic, and were composed of benzene rings combined with ethylene oxide units, and the molecules had different numbers of benzene units, and different ratios of ethylene oxide to benzene units.

With a standard emulsion under carefully standardized conditions, it was found that, using small amounts of reagent, an increase accelerated the rate of water separation. A mixture of an oil-soluble and a water-soluble material was more effective than either alone. One product mixed with alkyl–aryl sulphonic acid was more effective than the product or acid alone. For a fixed number of benzene rings an increase in the number of ethylene oxide units in the molecule accelerated demulsification, and for a given ratio of ethylene oxide to benzene units, there were advantages in favour of the molecules with most benzene units.

Using a second crude, it was easier to demulsify it when it had a larger water content, and at a high rather than a low

temp. Demulsification efficacy depends on the crude and the reagent. G. D. H.

451. High-pressure gas injection is a success. H. A. Koch. *World Oil*, 1956, **143** (5), 260.—It is claimed that extensive tests of high-pressure gas injection in secondary recovery have shown that oil recoveries of the order of 60% of in-place oil can be obtained, approx 3 times the recovery from solution gas drive.

The purpose of high-pressure injection is to obtain a miscible phase displacement of the oil and, although costs are high in providing for the increased pressures, increased recoveries, higher producing rates, and a higher ratio of producing to injection wells have justified the investment.

A possible disadvantage of the method is that the sweep-out pattern has a poor efficiency, particularly where the reservoir is non-homogeneous. 5 refs. C. A. F.

452. How vertical fractures affect cycling programme. P. B. Crawford *et al.* *World Oil*, 1956, **143** (5), 245.—The effect of simple vertical fractures on gas cycling projects was studied in a potentiometric model. The reservoir was a rectangular trough, 20 inches by 30 inches, filled to ½ inch with electrolyte, and vertical fractures were simulated by copper strips. The model provides the equipotentials and streamlines for steady state flow at unit mobility ratio. Experiments were carried out with vertical fractures parallel and perpendicular to the flow. Charts showing flow patterns in different cases are included. 4 refs. C. A. F.

453. Panhandle gas well fracturing pays off. R. D. Davidson. *World Oil*, 1956, **143** (2), 130.—Fracturing of gas wells in the Hugoton field of the Texas Panhandle has been highly successful, and there have been substantial increases in production. Field pays commonly have permeabilities of 1–5 mD with average porosities of 10–17% and acid solubilities varying from 25 to 90%. Silicate control agents have been used successfully in acidizing and fracture treatments, and acid-type gels have been used in most cases of fracture. Injection rates of 12–20 brl/min are satisfactory with 40–60-mesh sand in a conc of 1–2 lb/gal. Tables show the results of fracture treatment using different media. C. A. F.

454. Sedimentation in emulsions of water in petroleum. E. Tipman and G. W. Hodgson. *J. Petrol. Tech.*, 1956, **8** (9), 91–3.—In W. Canada heavy black crudes in a number of fields are produced emulsified with water and mineral matter. Measurements of the visc of dry McMurray crude and of McMurray crude diluted with kerosine have been made in a falling-sphere viscometer, the tube being 5·5 ft long and 2·5 ft in dia. The balls were bearings and ranged $\frac{1}{16}$–$\frac{3}{8}$ inch dia, and having been rendered radioactive were timed by their passage between 2 Geiger counters 3·64 ft apart. The temp were 70°, 100°, 130°, 160°, and 180° F. Wall corrections were applied in the calculations. The observed and calculated falling velocities agreed well, provided that the Reynolds number did not exceed unity. The rate of fall of the balls in emulsions of the crude, diluted crude, and aviation lub oils with water were measured for different water conc in the emulsions. The data for the emulsions fitted the relationsip $\eta = \eta_0(1 + C + 14C^3 + 8C^3)$ for the crudes and $\eta = \eta_0(1 + C + 14C^3 + 26C^3)$ for the refined oils, where η is viscosity of the emulsion, η_0 the viscosity of the oil, and C the vol conc of water. G. D. H.

455. Gas cycling yields 10,600 barrels daily for Mene Grande. K. E. Hard and J. R. Wiewall. *Oil Gas J.*, 19.11.56, **54** (81), 160.—Gas cycling is being carried out in 2 reservoirs in the Santa Rosa field of E. Venezuela, which forms part of the Anaco group. The field is an elongated dome with the accumulation controlled primarily by structure. Reservoir studies made in 1953 led to the development of the cycling project, and it is estimated that the process will recover at least 87·5 million brl white oil, or about twice that recoverable by preasure depletion. Engineering calculations on which the project was based are described, and structure and location maps are given. Reservoir characteristics and hydrocarbon analyses of each pay are listed. 4 refs. C. A. F.

456. New light on fracturing through perforations. M. H. Stekoll. *Oil Gas J.*, 29.10.56, **54** (78), 95.—Field tests have shown that when hydraulic fracturing is carried out through perforations the rate of injecting fluid largely determines how many perforations are fractured or are connected to fractures. Single perforations will take an appreciable amount of liq at normal pressures, and only a few of the perforations that will fracture at the lowest pressure may take all the injected fluid, leaving the remaining perforations unaffected.

If multiple fractures are required, the perforations should not be too closely spaced, and stage fracturing has been used successfully. A larger fracturing job does not necessarily provide additional fractures, but it may extend or enlarge the fracture. C. A. F.

457. Oil–water displacements in microscopic capillaries. C. C. Templeton and S. S. Rushing. *J. Petrol. Tech.*, 1956, **8** (9), AIMME Tech. Paper No. 4340, 211–14.—Capillaries 3·4–4·0 μ and 23–35 μ dia were used for studying oil–water displacements, the capillaries being initially water-filled. Displacement calculations, assuming perfect displacement and no capillary pressure hysteresis, gave effective viscosities for the oil which were less than the macroscopic viscosities. The values decreased with decreasing capillary dia and increasing oil–water visc ratio, features which could be explained by the presence of a water film 20–260 Å thick on the capillary wells. For capillaries first filled with oil the effective oil visc was highest for the first water displacement, and sometimes exceeded the normal oil visc, but decreased with subsequent displacement. Surfaces first contacted with oil have a tendency to be oil-wet, and the initial water displacement may not remove all the oil, but may leave temporarily globules, patches, or tori of oil. G. D. H.

458. Effect of a short term shut-in on a subsequent pressure build-up test on an oil well. R. G. Nisle. *J. Petrol. Tech.*, 1956, **8** (8), 67–8.—Sometimes before a pressure build-up test can be made a well has had to be shut in for some reason or other, *e.g.* to install a valve, or because of shortage of tankage. The effect of such a shut-in period on the subsequent build-up has been examined. The Kelvin point-source solution was used, an expression for superposed effects being derived. The conclusion was reached that if the flowing time following a short term shut-in is at least 10 times the duration of the short term shut-in, ignoring the latter will introduce an error not exceeding 10% of $\frac{\Delta T}{T + \Delta T}$, where T is total time up to shut-in test and ΔT is the shut-in time for test.

An example of the use of the procedure is given. G. D. H.

459. Squeezing inhibitor into formation. R. H. Poltker and J. D. Stone. *Petrol. Engr*, 1956, **28** (5), B29.—A new method of treating corrosion in gas-lift wells is described, in which inhibitors are squeezed back into the formation. This has increased the treating efficiency by 16·9% and reduced treating costs by 49·9%. 11 wells were tested by the method, and the case histories of 5 are given. The field selected was Placedo in Victoria County, Texas, developed in 1936 and 1937, where tubing failures due to corrosion were first noted in 1948. C. A. F.

460. Down-hole chambers increase gas-lift efficiency. Pt 1. H. W. Winkler and G. F. Camp. *Petrol. Engr*, 1956, **28** (6), B87.—The use of down-hole accumulation chambers in gas-lift wells is described. They provide a relatively cheap and trouble-free method of lifting which is particularly applicable

to low bottom-hole pressure wells which are to be stripped to depletion. The method also cuts lifting costs, reduces gas–fluid ratios, and gives max fluid recovery with minimum fluid head.

Diagrams of different types of chamber installation are included, and it is shown that there are 4 basic types of chamber design: conventional chamber installation, insert chamber with packer several hundred ft above chamber, 2-packer chamber with upper packer in casing and lower in liner, and a chamber installation with dip tube larger than tubing. Specimen examples of each of these are given.

C. A. F.

OILFIELD DEVELOPMENT

461. Drilling peak hit in July. Anon. *World Oil*, 1956, **143** (4), 110.—5114 wells were completed in the U.S.A. in July 1956, and estimated total for 1956 is 59,000. A table shows U.S. well completions for July 1956, and first 7 months, 1955–56. C. A. F.

462. Montana boasts fabulous oil reserves. Anon. *Oil Gas J.*, 19.11.56, **54** (81), 362.—Proved recoverable reserves of Montana are estimated at 354 million brl. The most important pay is the Mississippian Madison limestone at Elk Basin, and primary recovery from this zone is estimated at 32,700 brl/acre. Main Cretaceous reservoirs are the Shannon, Frontier, Colorado, and Kootenai, but they produce in only a few fields. Jurassic Ellis and Morrison are locally productive, and in the Pennsylvanian the only important pay is the Tensleep. Oil is also produced from the Mississippian Amsden, the Red River, and the Silaro-Ordovician. A list of the fields of Montana with production data is included.

C. A. F.

463. Old faithful flows again. A. Gibbon. *World Oil*, 1956, **143** (5), 108.—The discovery well of the Cushing field in Oklahoma, which was abandoned in 1948 after producing for 35 years, has been worked over, and after fracture treatment has been completed in the Red Fork. On test the well flowed 272 brl in 10 hr. On abandonment in 1948 the well was producing only *ca* 1 b.d. Cushing has produced over 400 million brl oil since its discovery in 1912. C. A. F.

464. Chile pushes production and refinery runs. J. S. Barwick. *Petrol. Engr*, 1956, **28** (7), E5.—A number of oilfields have been discovered in the Magallanes basin of S. Chile since the war, following a period of unsuccessful exploration from the 1920s. The first field found was Manantiales in 1945, and production started in 1950. Since then fields have been found at Cerro Sombrero, Victoria Sur, Rio Side, Cullen, and Flamenco, all of which are in the same general area, producing from the basal Cretaceous Springhill sandstone and fractured rocks just below.

In 1954 a refinery was completed at Concon, N. of Valparaiso, and at present the fields' production, amounting to *ca* 10,000 b.d., is being shipped there by tanker. C. A. F.

465. Papuan Apinaipi programme. Anon. *Chem. Engng Min. Rev*, 1956, **49** (1), 10–11.—Papuan Apinaipa Petroleum Co's programme for testing permit area No. 22—occupying 8600 sq miles W. of Port Moresby—is described. In Vailala River area—pt of Aure Trough—alternating greywacke and siltstone beds of Miocene age are developed to >21,000 ft. Miocene beds, dominantly marine, are overlaid to E., S., and W. by Pliocene sandstones, conglomerates, and siltstones, also coal. Sediments are strongly folded and faulted, with surface indications of oil and gas along anticlinal folds. 3 large anticlines in Vailala River area, Iavokia, Ivori Junction, and Nakoro merit attention, the first is 13 × 2½ miles with a NW.–SE. trend, and crest marked by a strike fault. Oil accumulations may be met at <4000 ft of surface. In Lower Tauri River area—Lakekamu Embayment—Tertiary stratigraphy is masked by Recent and Pleistocene alluvium. Max known thickness of Miocene sediments is 6500 ft in Yule Island–Oroi area; Pliocene sediments recorded = 4000 ft max thickness, including basal 1000 ft reef limestones. In Yule Island–Oroi area Pliocene rocks have been deposited on an eroded platform of Middle Miocene sandstones and limestones, the latter exposed along axes of anticlinal structures. Other Miocene sediments are covered still by later beds. Miocene beds are being investigated as an oil source, with Pliocene beds as impervious cover. Proposed examination of Lesi–Maiva area is described. R. T.

466. Russia makes slow progress in "Second Baku." C. L. Adams. *Petrol. Engr*, 1956, **28** (11), E13.—The "Second Baku" area is centred in the Bashkiria and Tataria areas between the Volga river and the Ural Mountains of the U.S.S.R., and production from the region now exceeds that of the Azerbaijan Baku fields on the Caspian Sea.

Discoveries in Siberia have been disappointing, but exploration continues, and production from Sakhalin is inadequate for the E. provinces.

Plans have been made for pipelines from the Tuimaza and Ufa fields to Omsk, and refineries are to be built in the upper Amur valley in E. Siberia and in the Krasnoyarsk area of central Siberia. Ultimately a 4000-mile trans-Siberian pipeline is to carry oil from "Second Baku" to Khabarovsk, N. of Vladivostok. Oil from the area is now piped to refineries at Kuibyshev, Ishimbai, and Saratov, as well as at Ufa and Omsk.

Some of the fields of the region are being water flooded for secondary recovery, and hydraulic fracturing has been introduced to a limited extent. Turbine drilling has increased drilling speed. C. A. F.

467. Italy—future oil reservoir of Europe. C. H. Savit. *World Oil*, 1956, **143** (2), 84.—Although oil has been known in Italy since Roman times, it was not found in important commercial quantities until 1954, but there has been important gas production since 1944. During 1955 4 additional discoveries were made in the Abruzzi area, and the accumulated evidence suggests that Italy may become an important oil-producing country.

All the recent discoveries have been shut in pending a new petroleum law, but active exploration is continuing. Some of the problems of seismic prospecting in Italy are outlined, and a seismic cross-section of the Cortemaggiore field in the Po Valley is included. 4 refs. C. A. F.

TRANSPORT AND STORAGE

468. 5-year tanker plan to take billions. Anon. *Oil Gas J.*, 12.10.56, **54** (84), 88.—Tankers on order or under construction will increase size of world tanker fleet by more than 50%, and cost $1½ billion annually for the next 5 years.

An 84,730-ton super-tanker completed its maiden voyage in Nov 1956, and 3 × 100,000-ton ships are proposed. Ships of over 45,000 tons cannot pass through the Suez Canal.

G. A. C.

469. An enclosed depth gauge for tankers. Anon. *Mot. Ship*, 1957, **37** (440), 425.—The automatic marine tank gauge is manufactured by Whessoe Ltd under licence from Shand & Jurs Co, California. This reduces fire risk and vapour loss during loading and unloading. Several tanker companies have adopted the method, which incorporates a closed venting system. The liq level in the tank is measured by enclosed sight gauges, and ullage plugs may be kept shut at all times.

To prevent excessive pressure developing during loading, a weighted ullage cover designed to lift at a pressure of 2 p.s.i. is fitted in each cargo tank hatch cover in addition to the usual ullage plug. D. K.

470. Tanker development in 1956. Anon. *Mot. Ship*, 1957, **37** (440), 436.—The trend has been towards larger, faster vessels. Diesel machinery has been used to a greater extent, and the outlook is for a further increase in the number of vessels with this type of propulsion. D. K.

471. Today's shifting tanker situation. J. J. Winterbottom. *Oil Gas J.*, 31.12.56, **54** (87), 107.—Make-up is presented of present and projected tanker fleet, with a forecast of possible future industry tonnage supply–demand position. Tables illustrate the article. G. A. C.

472. Storage of fuel oil. T. Chippindale. *Fluid Handl.*, 1957, 7–10.—Abstract of paper given to Inst. H.V. Engrs, dealing with delivery, pumping, and storage of fuel oils. The trend is towards the use of heavier fuel oils, and recommended handling, tank storage, and line pumping temp are given for several grades. Some aspects of storage tank construction, ancillary equipment, and safety precautions are also discussed. W. A. M.

473. Transmitting fluids at constant temperatures. Anon. *Fluid Handl.*, 1957, 20–2.—Description of the use of electrical heating tapes for pipes conveying viscous fluids. Tapes are available for heating pipes to 300°, 450°, or 600° C, and there are special tapes for use in moist atm or wet conditions and for frost prevention in exposed pipes. W. A. M.

474. How one company solved its problems offshore. R. C. Ledford. *Pipe Line Ind.*, 1956, **4** (5), 42–4.—Beach line and platform risers are crit maintenance sections in Marine Gathering Co's line laid in 1950. At the seaward end corrosion protection and possible movement between buried line, riser, and platform require careful attention. At the platform marine swing joints provide flexibility. Maintenance at the shoreward end is made difficult by shifting beach line. Since 1955 impressed currents are supplied from diesel-driven generators on the producing platforms. Two Se, 30-amp, 15-V, oil-immersed rectifiers and high-silicon iron anodes are installed at the platforms. Sufficient current is impressed upon the system to provide protection along the entire length of line. Platform and beach are the only check points used. R. T.

475. Planning the offshore line. C. Aldridge. *Pipe Line Ind.*, 1956, **4** (5), 39–41.—Magnolia finds the cost of barging *ca* 5 times that of transporting by a 48-mile pipeline. Land survey methods adopted are described. Capacity of 12-inch line operating under 2-phase flow at 1000 p.s.i. is 12,000 b.d. oil and 10,500 M.c.f. gas. R. T.

476. Work with the weather—it's cheaper. D. R. Gayle, Jr. *Pipe Line Ind.*, 1956, **4** (5), 35–8.—Study of weather maps and wave reports permits evaluation of task and equipment for operations in the Gulf of Mexico. Data are used for long-range planning, weekly forecasts to schedule operations, and day-to-day forecasts during operations. R. T.

477. New ideas promise faster pipe laying offshore. M. A. Judah. *Pipe Line Ind.*, 1956, **4** (5), 32–4.—The "Friction Transposition" method described and illustrated is designed for the longest and deepest pipelines anticipated for the Gulf of Mexico. Effects of bad weather and stormy seas are offset. A pulling barge equipped with a heavy-duty winch—pulling capacity 220,000 lb—to handle *ca* 12,000 ft of 2·5-inch anchor chain is used. Underwater lines up to 50 miles are planned. R. T.

478. What the Gulf can do to a pipeline. J. C. Freeman and C. L. Bretschneider. *Pipe Line Ind.*, 1956, **4** (5), 28–31.—Problems faced in offshore pipelining are discussed. Shear strength of sediments, effect of waves (resonant frequencies), hurricanes, tides, and currents must be studied. Corrosion and biological attack—the teredo attacks cellulose, certain bacteria attack asphalt—are to be considered. Economy depends on careful prospecting and maintenance. R. T.

479. What about UHF scatter systems for pipelines? R. M. Ringoen. *Pipe Line Ind.*, 1956, **4** (6), 54–9.—UHF transhorizon (scatter) communication systems compare favourably with line-of-sight relay systems as regards waste of spectrum. This should be an important factor in determining to what extent UHF transhorizon systems should be employed for pipeline systems in areas where spectrum congestion may exist. Factors to be considered in comparing interference-producing capabilities of a line-of-sight and scatter system performing the same service are given. Specifications for the 2 systems are given. A full discussion follows. R. T.

480. Computers speed products scheduling. D. L. Fayman. *Pipe Line Ind.*, 1956, **4** (6), 35–8.—Electronic computers make rapid mathematical analysis of the network to evaluate operating practices and management policies. Great Lakes research team permits improved service to shippers resulting from daily production of 28-day advance schedules. Scheduling—an attempt to predict future status of a pipeline resulting from current status—thus influences current decisions regarding shipping dates, proposed grades and volumes of movements, and proposed pumping schedules. R. T.

481. Unique problems on NATO pipelines. J. R. Shipley. *Pipe Line Ind.*, 1956, **4** (6), 33–5.—The defensive pipeline system set up by the 15 member countries of NATO is restricted severely by lack of equipment, labour problems, and legal regulations. R. T.

482. Fluid temperature rise = pump efficiency. G. P. Jennings and L. P. Meade. *Pipe Line Ind.*, 1956, **4** (6), 26–30.—Temp rise of crude is key to the method discussed for engine-driven centrifugals. Overall eff is the ratio of hydraulic h.p. of the pump to hydraulic h.p. + all losses within the pump. Only measurements required are temp rise in pump, gravity, and pump differential pressures. R. T.

483. 7-mile Colombian pipeline stretch one of the toughest. Anon. *Pipe Line Ind.*, 1956, **4** (6), 50–4.—The $5·2 million Buenaventura-to-Cali project in W. Colombia—one of the roughest and most difficult—includes in its 64 miles 21 canyon crossings, 8 underwater crossings, and 13 suspension bridges. Details are given of the construction, with special reference to one 7-mile section. R. T.

484. Weight coating applied by extrusion. L. Resen. *Oil Gas J.*, 10.12.56, **54** (84), 114.—Specially-designed extrusion equipment mounted on a barge applied a high-density rubberized asphalt mastic coating to 28 miles of pipe for Southern Natural Gas Co, Louisiana. Coating is tough and flexible, does not chip, and has electrical resistance 13 times better than concrete; its dissipation factor is 4 times better than coal tar. G. A. C.

485. Big-inch lines through Turkey studied. Anon. *Oil Gas J.*, 3.12.56, **54** (83), 66.—Proposals are outlined for new pipelines from the Middle East to the Mediterranean and expansion of current projects. Line will skirt Lebanon, Jordan, Syria, and move over 1,000,000 brl to the Mediterranean. European pipeline is also planned. G. A. C.

486. Over 900 engineers attend San Antonio regional meeting. Anon. *Pipe Line News*, 1956, **28** (11), 62.—Abstracts of 12 papers of interest to the petroleum industry presented at the American NACE conference in Oct 1956. D. B. S.

487. Electric power analysis for products pipeline terminals. A. E. Whiteside. *Pipe Line News*, 1956, **28** (10), 40–6.—Products being pumped and, consequently, electric power requirements, are continually changing in a pipeline system. Considerable economies in consumption and information concerning load capacity relationships may be achieved by maintaining a continual electric power analysis. This analysis is described in detail. D. B. S.

488. Measurement methods for wear in pipeline engines and compressors. J. L. Wilson and S. R. Sawyer. *Pipe Line News*, 1956, **28** (7), 36–40.—The most economical method of pump and compressor maintenance is to repair after considerable wear has taken place but before breakdown occurs. The problem of determining this point is discussed. A large amount of work has been carried out on different types of engine in order to relate engine wear to the amounts of different metals present in the lub oil. Small amounts of metals were satisfactorily identified and measured by the use of an emission spectrograph, and these quantities related to the actual wear of different parts of the engine. It is now possible to predict with some accuracy when and where failure is likely to occur. The use of detergent lub oils complicates the procedure due to the additives present, but this aspect is receiving attention. D. B. S.

489. Procedures for pipeline efficiency testing. R. F. Bukace and R. T. Ellington. *Pipe Line News*, 1956, **28** (7), 27–33.—The flow efficiency in a gas pipeline system is the ratio of the measured flow to that calculated by the use of a flow equation for the same operating conditions. Measured flow may be obtained by the use of an orifice meter or by tracers; the latter technique, and particularly the use of anhyd ammonia, is fully discussed. 3 general equations available for calculating the gas flow and methods of measuring the quantities required (*i.e.* physical properties of the gas and dimensions of the pipeline) are described. D. B. S.

490. What causes underbead cracks in welds. A. M. Hill and F. W. Zilm. *Oil Gas J.*, 17.12.56, **54** (85), 108.—A new maintenance-welding procedure by Service Pipe Line Co for use on pipelines where the pipe-surface temp is below 50° F is described. Methods and materials to be used are outlined, and tests show common method of repairing corrosion pits should be restricted to low and medium carbon grades of pipe. G. A. C.

491. How to figure your power needs. A. E. Whiteside. *Oil Gas J.*, 31.12.56, **54** (87), 192.—Examples are given and worked out for calculating electricity requirements for pipeline deliveries of products. Figures give circuits for controls, load and demand factors, delivery/kW-hr. Test equipment is listed and method reviewed. G. A. C.

492. Ductile iron—a new material for petroleum pipe. M. Grandpierre and C. C. Reynolds. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 11–16.—Ductile cast irons are described and compared to other cast ferrous metals. Tests on the strength and corrosion resistance of ductile iron pipe are described. High-pressure gas pipelines and filling pipes on tankers are discussed as typical applications. It is concluded that ductile iron's unique combination of properties has made it a new material for petroleum application. (Authors' abstract.)

493. Automatic measurement of crude oil. M. H. Atkinson and A. H. Newberg. *Pipe Line Ind.*, 1956, **4** (6), 30–3.—Views are expressed on the future of automatic measurement and control of crude oil. The oil industry is in the interim period between use of manual methods and automatic device adoption. Instruments for acceptable determination of B.S. & W.—the crit measurement—and gravity would remove the need for most sampling and testing in crude oil measurement. R. T.

494. Buy power, or make your own. W. H. Stueve. *Oil Gas J.*, 24.12.56, **54** (86), 64.—Points to be considered before deciding include expected life of project, interest and depreciation rates, operating labour, maintenance, type and cost of fuel, cost of electric power, seasonable demands, standby units, and economic pipe diameters. G. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

495. The changing product demands on our refineries. A. L. Lyman. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 438–43.—Future changes in demands on U.S. refineries will result from 2 main factors: increased energy requirements and changes in product quality and formulations.

It is estimated that the total petroleum demand on U.S. refineries will reach slightly over 11 million brl daily by 1965, which will require increased refinery capacity. It is expected that gasoline will continue to be the product largest in volume, with dist second largest. The reduction in yield of residual fuels, already apparent, will continue, but more slowly.

The changes in product quality, however, will have more significance for the refiner because these changes will require changes in equipment and processes. The higher octane trend will continue, requiring the installation of more cat equipment. Eventually, new processes will have to be developed to keep pace with the demand for higher O.N. No relief through the application of automotive turbines is expected. Volatility and vapour pressure will require tailoring to the requirements of the automobile of the future. The expanding use of additives for both gasoline and lubricants will require the handling of more special chemicals. Increased aromatic content of high octane gasoline may make such constituents short for the increasing petroleum chemical market.

Whatever the demands, the industry will meet them.

(Author's abstract.)

496. Planning and building the refinery for minimum maintenance. R. E. Redfield. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 403–6.—Ultimate maintenance costs greatly depend on the initial selection of materials. Minimum maintenance costs can be obtained if full consideration is given to: (1) use of properly installed high-quality materials; (2) proper sizing of equipment; (3) installation of the least number of pieces of equipment; (4) max standardization; (5) built-in provisions for efficient maintenance.

2 refineries in France were rebuilt following the foregoing principles. Both refineries now have excellent maintenance records.

Tubular heat exchangers were standardized to provide 3 designs. The tubes are 1-inch o.d., 10 gauge, 16 ft long on 1¼-inch square pitch, mostly steel and admiralty. All bundles of the same dia are interchangeable. In general, dirty bundles are replaced during a turnaround with a clean bundle. A minimum inventory of tubes and gaskets is required.

Process pumps are of 4 different sizes. When repairs are necessary, it is possible to replace a pump and then overhaul the used pump in the shop. This policy has resulted in a small inventory of spare parts.

Furnaces were designed with tubes of 2 lengths, 2 diameters, and 2 wall thicknesses. Initial design was for a transfer rate of 8500 B.t.u/hr/sq. ft. Except for some tube failures caused by salt in the crude oil, there have been no repairs of any magnitude during the 4 to 8 years the furnaces have been operating.

Piping was laid out to keep maintenance down. It was essentially all welded, with many connexions of ring-joint flanges. There have been few piping leaks in either refinery. The improvement in house-keeping is very significant.

Most pumps are electrically-driven, and only process steam is needed outside the powerhouse. The lub oil refinery uses 140 lb of steam/brl of crude oil. The other refinery uses only 40 lb/brl of crude oil and has no exhaust-steam system.

It is much easier to observe the foregoing principles when building a new refinery than when remodelling an old refinery. However, if these ideas are considered the ultimate goal, then they can be eventually achieved and maintenance costs will reflect their value. (Authors' abstract.)

497. Scheduling refinery maintenance. C. E. Gunter and W. D. Armintor. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 407–10.—Max efficiency of the maintenance forces at Gulf Oil Corpn's Port Arthur, Texas, refinery is achieved through advance planning of unit turnarounds and daily scheduling of the working force. For maintenance purposes the refinery is divided into 3 zones, each covering one of the major departments—light oil, lubricating, or pressure still—and one or more smaller departments. Quarterly schedules of shutdown periods for cleaning and repairs to the major units are prepared each month, reviewed weekly by both operating and maintenance department heads, and revised if necessary. If possible, major unit turnarounds are scheduled to allow a minimum of one week between completion of one and start of another, and minor turnarounds are used to balance the overall maintenance schedule. To facilitate maintenance accounting, each repair is covered by a work order. The maintenance forces are scheduled on a day-to-day basis, except for employees kept on fixed routine maintenance assignments, those in the shops, and the truck and heavy equipment operators. Tools are supplied by one main tool house and 2 large, fully equipped mobile trailers. (Authors' abstract.)

498. The effect of standardization on maintenance. H. O'Neill, Jr. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 411–16.—Standardization of refinery equipment to a limited number of models, sizes, and/or materials, provided by only a few manufacturers, can save money and time by favouring competitive bidding, permitting max interchangeability of spare parts, and making quantity discounts and other price extras possible. It also simplifies maintenance by reducing the amount of specialized knowledge required of mechanics, machinists, and the like, and reduces the required inventories. Standardization should be co-ordinated among the operating, research, storehouse, engineering, and purchasing departments. Valves, valve trim, alloy-steel pipe, flanges, welding fittings, and centrifugal pumps are examples of equipment on which substantial savings can be realized. Quantity discounts on several types of equipment are shown by a table and charts. (Authors' abstract.)

499. Use of contract maintenance crews for large-scale refinery turnarounds. J. W. Towler. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 417–23.—This paper describes the use of general maintenance contractor crews as used to provide a fluctuating supply of craftsmen for the major Union Oil Co refineries at Los Angeles and Oleum, California. The procedure involves the use of a combination of fixed company forces, semi-permanent contractor crews, and variable contractor crews. Based upon 6 years of experience with this policy, Union Oil Co has found that its widely fluctuating manpower requirements for turnarounds can be adequately satisfied. (Author's abstract.)

500. Physical equilibrium for equipment design. II. J. O. Osburn. *Chem. Engng*, 1956, **63** (12), 211–16.—The characteristics of one-component (pure substance) and of 2-component systems, the latter including retrograde condensation, and the equations which define equilibrium are discussed. The use of relative volatility and equilibrium vaporization ratios for hydrocarbons is developed. K-charts and their function in calculating equilibrium compositions and relative amounts of vapour and liq are described. 2-component systems with more than 2 phases are considered briefly.

D. H. A.

501. Europe's largest refinery continues its expansion. Anon. *Oil Gas J.*, 31.12.56, **54** (87), 188.—Shell's Pernis plant at Rotterdam now has a crude throughout of 220,000 b.d., with a large petrochemical output. Resins, gas processing, propane–propylene, sulphur, and glycerine are among subjects reviewed. G. A. C.

502. Considerations affecting more economic but equally safe pressure-vessel construction utilizing either present-day ductile materials or new high-strength less-ductile materials. J. J. Murphy, C. R. Soderberg, Jr., and D. B. Rossheim. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 258–87.—Code requirements for pressure vessels are presently associated with extremely ductile materials and safety factors sufficiently ample to limit consideration to principal stresses evaluated by simple formulæ. Advancements in physics have extended present knowledge of the fundamental behaviour of metals, and metallurgical progress has provided new, improved, and special-purpose materials, many with physical properties enhanced by chemistry, heat treatment, or cold-work with concurrent reduced ductility. The horizons of both analytical and experimental stress analysis have been vastly extended. Also new and improved inspection techniques and equipment are available. Since world war I pressure vessel demands of the process, power, and other industries have rapidly increased in number, size, and complexity. In many cases this requires more precise design and fabrication, with attendant justification of lower safety factors and improved economics. This trend toward balanced or adequately proportioned pressure vessels is further accentuated by new, critical materials whose greatly increased cost justifies the objective of higher working stresses as obtained from improved design, fabrication, materials, and inspection. It is the aim of this paper to indicate tentative basic principles for revision of the ASME pressure-vessel codes to a broader base to suit the wide variations in service and economic demands.

(Authors' abstract.)

503. Installing flexible tubing and packless pipelines joints. L. W. Passmore. *Pipes & Pipelines*, 1956, **1** (2), 20–2.—Seamless metallic tubings in Cu alloys, *e.g.* Tombac, are produced by drawing and corrugating methods without welding, soldering, or folded seams. They are recommended for rough conditions in conveying steam, air, or gas in dia ¼–4 inches. Smaller sizes are used for insert pieces in gas supply of industrial furnaces to eliminate vibrations. Larger sizes are used for gas-holder sealing troughs, damming noise of compressors, pumps, etc. Other uses are for steam to platen presses, vulcanizing presses, for handling oil, petrol, alk soln, etc. Design details are given; reciprocating movements should be minimum, bending radii should be kept at a max, and torsional stresses avoided. Correct choice and fixing of fittings are important. Correct and incorrect examples of installations are illustrated. Packless pipe joints—in Tombac or stainless steel—using pieces of flexible metallic tubing or corrugated metallic bellows—are ready-made for insertion into pipelines where noise or vibration make them advisable. They are used also as expansion joints in hot pipelines carrying steam, hot H_2O, condensate, etc., over great distances. Typical examples of layouts, as elastic members for supply or delivery pipes for steam-heated boiling vessels, compressors, gas boosters, or vac pumps. Examples of correct and incorrect installation are illustrated. Special expansion pieces

for steam turbines, allowing universal movement and keeping the turbines stress-free, are illustrated and described. R. T.

504. Prefab wall makes two ponds of one. L. Resen. *Oil Gas J.*, 10.12.56, **54** (84), 136.—Cosden Petroleum Corpn have installed a cooling pond wall at their Big Spring, Texas, refinery without shutting down cooling tower or draining existing pond. Precast concrete sections were used, joined with U-bolts and sealed with asphaltic cpd. Small pond eases treating problem, large one acts as reservoir. G. A. C.

505. Steam plant uses distilled sea water. D. H. Stormont. *Oil Gas J.*, 3.12.56, **54** (83), 131.—The use of sea-water evaporators by Pacific Gas and Electric Co to manufacture fresh water for boiler and other operations at the new Monro Bay steam plant, San Luis Obispo, California, is described. 2 sets of sea-water evaporators are used, one for each of 2 boilers which supply 156,000-kW turbine generators. G. A. C.

506. How to plan a monowave radio relay system. D. R. Marsh. *Oil Gas J.*, 3.12.56, **54** (83), 127.—This is the second of a 2-part article and deals with location of sites, antenna polarization, tower light control, and aux power. G. A. C.

DISTILLATION

507. Analytical experiences in producing pure aromatic hydrocarbons. (In German.) F. Trefny. *BrennstChemie*, 1956, **37** (19–20), 317–23.—Production of pure aromatic hydrocarbons from pressure-refined coke oven benzol is discussed. In large dist installations with highly effective columns operation is continuous. It is essential to adjust accuracy and reproducibility of analysis to apparatus selectivity and to test hydrocarbon purity as rapidly and reliably as possible. Analytical control is by set. pt., *d*, *n*, and boiling span. Conventional instruments are inadequate for the selectivity of the installation. Sensitivity—particularly of the thermometers—is essential. A series of new thermometers developed for set. pt. and boiling span were graduated in $\frac{5}{1000}°$. Rough formulæ deriving from cryoscopy, areometry, and refractometry, and mutually independent, are given for purity determinations. Accuracy of formulæ is checked with standard mixtures. The boiling span is used to test pure products and detect azeotropic mixtures. The influence of raising analytical accuracy on installation economy is described. R. T.

508. Mechanism of thermal decomposition of fuels. (In German.) S. F. Tshuchanow. *BrennstChemie*, 1956, **37** (15–16), 234–9.—Thermal decomp of a fuel mol by slow heating cannot be regulated, as shown by analysis of heating rate and kinetics of the chem reaction. Heating at a higher rate with fixed temp rise permits decomp control and product modification. The simplest practical method for regular heating with max speed is heating small fuel particles in a gas stream. In thermal decomp of coals characteristic groups of reactions result in sp product formation. The role of individual reactions and quantity and composition of the products of the thermal decomp depend on the mode of operation and composition and structure of the raw material. Development of secondary reactions of the pyrolysis which takes place in a steam–gas mixture can be regulated by heating at max rate with strictly fixed operation. By such a max-rate pyrolysis valuable liq and gaseous products are obtained by repeated thermal decomp of low-grade pt of the original tar, or by decomp of heavy liq fuels specially added to the steam–gas mixture. 14 refs. R. T.

SOLVENT EXTRACTION AND DEWAXING

509. A study of the errors involved in extraction calculations due to the application of ternary diagrams to multi-component systems. L. Alders. *J. Inst. Petrol.*, 1956, **42** (392), 228–31.—The paper is concerned with the errors which arise when multi-component systems are simplified to 3-component systems and represented on ternary phase diagrams. This is done by denoting feed composition and extraction products by physical constants. It is stressed that this simplification and, for an example, its application to the Hunter and Nash construction, can lead to a low value for the number of stages required to effect a given separation. 10 literature refs. C. B.

510. Selective solvent for aromatic hydrocarbons. (In Italian.) D. Ripa, A. de Angelis, and V. Berti. *Riv. Combust.*, 1956, **10** (11), 803–29.—The properties of *bis*-(β-cyanoethoxy)-ethane-1,2 as a selective solvent for aromatic hydrocarbons have been investigated. The paper describes the synthesis of the solvent and experimental determination of miscibility gap at 25° C for a certain number of ternary systems of the aromatic *n*-heptane solvent type. The values were calculated of *bis*-(β-cyanoethoxy)-ethane-1,2 capacity and selectivity, which proved to be satisfactorily versatile in separating aromatic from non-aromatic hydrocarbons. Figures representing distribution balances of the solvent were compared with those for other solvents studied up to now, and optimistic conclusions were drawn in reference to extending the study to the extraction of aromatic substances from petroleum dist. (Authors' abstract.)

CRACKING

511. Update your reactor design method. J. C. Chu. *Chem. Engng*, 1956, **63** (12), 183–6.—To make a cat process a commercial success the activity of the cat and the product yield should be high and the cost of cat low. The development of the rate equations for both homogeneous and cat reactions is considered. Rate data taken from the literature should be confirmed by lab work on either a differential reactor or, preferably, an integral reactor. D. H. A.

512. Vacuum-tower overhead gets a cleaning. L. Resen. *Oil Gas J.*, 10.12.56, **54** (84), 111.—Electrical precipitation technique is used to remove water and thus make increased steam stripping possible in vacuum unit at cat cracking plant of Eastern States Petroleum Co, Houston. The method separates the brackish water and entrained steam condensate from the gas oil. G. A. C.

513. Cat reformers hit top octanes. T. P. Forbath. *Chem. Engng*, 1956, **63** (12), 374–7.—3 of the latest cat reforming processes to make 100-plus octane fuels are Rexforming, Iso-Plus Houdriforming, and Powerforming. Each is essentially a fixed platinum-bed process in which naphtha stocks feed continuously through cat-packed reactors in a H_2 atmosphere. Upgrading results from dehydrogenation of 6-membered naphthenes, isomerization of 5-membered rings to 6 followed by dehydrogenation, and dehydrogenation of paraffins followed by cyclization. A description and flowsheet of each process is given. Rexforming maximizes the dehydrocyclization reaction by extracting aromatics and recycling the low octane stream. Iso-Plus's thermal reactor cracks long-chain paraffins while 2 other reactors extract aromatics. Powerforming uses severe conditions which make regeneration of the cat necessary. D. H. A.

514. Unifining—a proven refining technique. G. H. Hemmen, A. E. Kelley, M. J. Sterba, and D. Read, Jr. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 334–44.—Unifining was introduced early in 1954 with the operation of the first commercial plant at United Refining Co, Warren, Pennsylvania. Since that time 10 commercial units have been placed in operation, and 16 more are at the design or construction stage. The number of current applications represented by these units

is illustrative of the versatility of the process. Refiners today are faced with increasing quality demands for many products. Quality improvement is shown to be effected through Unifining, and results from the commercial operation of a number of Unifining plants are presented. In addition, a number of proposed commercial applications of Unifining are described. 3 typical cases are given to illustrate the economics of the process. The 26 plants in operation and at the design or construction stage represent more than 220,000 b.d. capacity. (Authors' abstract.)

515. Vapour-phase hydrodesulphurization applied to cracked naphthas and light straight-run intermediates. M. D. Abbott, G. E. Liedholm, and D. H. Sarno. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 345–51.—The Shell Oil Co has operated 2 selective vapour-phase hydrodesulphurization plants for nearly 10 years. The process employs a tungsten–nickel-sulphide cat at pressures from 500 to 750 p.s.i.g. Temp vary from 450° to 700° F, depending upon the feed and the condition of the cat. The operation is carried out in the vapour phase with low hydrogen-to-oil ratios. Performance data are presented for commercial operations during the production of: (1) aviation-gasoline blending stock; (2) motor-gasoline blending stocks; (3) light intermediates.

Operating and capital cost estimates are presented for the selective hydrogenation of thermally and cat cracked naphthas, and comparison is made with costs for acid treating and re-running. One case assumes that existing acid-treating facilities are retired when the selective-hydrodesulphurization plant is commissioned. In this case the $2,000,000 capital cost of the new unit is returned (before taxes) in 2·5 years and 1·6 years for cat cracked and thermally cracked naphthas, respectively. If acid-treating facilities are not available and the option is between building a new acid-treating unit or a new hydrodesulphurizing unit, the differential capital cost of $1,300,000 is returned in 1·6 years and 1 year, respectively. (Authors' abstract.)

516. Processing of heavy high-sulphur crude oil in a low-sulphur refinery. W. H. Winslow and J. Weikart. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 352–8.—The heavy fuel oil yield is tripled—16½% *v.* 5½%—when 25,000 b.d. of heavy high-sulphur crude oil is substituted for a like amount of light low-sulphur crude oil in a hypothetical 100,000-b.d., Gulf Coast refinery. This is accompanied by product quality degradation and increased corrosion. The fluid coking process and the Hydrofining process are shown to join hands in providing an economic solution to the problems of adding high-sulphur crude oil to a low-sulphur refinery.

Fluid coking reduces the high residual fuel oil yield, while making middle dist, gasolines, cat cracking feedstocks, and a small amount of by-product coke. The addition of a fluid coker to the hypothetical refinery, which is running a 25 : 75 mixture of high- and low-sulphur crude oils, increases the yield of middle dist by some 12,000 b.d.

It is more economical to Hydrofine the high-sulphur virgin and coker gas oils prior to cat cracking rather than to Hydrofine the products from cat cracking of all the gas oil. This has several advantages: (1) it produces products which require little finishing; (2) it removes sulphur from cat cracking feedstock, and hence reduces corrosion in this unit; (3) it improves the cat cracking quality of the gas oil. This reduces its carbon-forming tendencies and allows the cat cracking unit to operate at higher conversions. Hydrofining of cat cracking feedstock increases gasoline yield by 2700 b.d., largely at the expense of heating oil.

The addition of fluid coking and Hydrofining of cat cracking feedstock requires a net investment of $10,300,000 and adds $2,600,000/year to the operating costs. The added product value is $8,000,000, which provides a 52% return/year on the investment. (Authors' abstract.)

517. Thermal cracking of aliphatic petroleums in presence of diluents and hydrogen. (In German.) J. Varga, G. Rabó, and A. Zalai. *BrennstChemie*, 1956, **37** (15–16), 244–51.—Decomp of high-asphalt cont Hungarian petroleum under 70 atm H_2-pressure into lower mol. wt. hydrocarbons is discussed. Decomp of the asphalts and hydrogenation of decomp products takes place in 2 stages. Temp has a decisive effect in high-mol hydrocarbon cracking, whilst off of subsequent hydrogenation depends on tetralin quantity remaining in the liq phase. H_2 liberated from tetralin saturates unstable decomp products preventing further coke-forming reactions. This effect applies especially if tetralin concn in the asphalt-containing liq phase is 10 wt % minimum. Coke formed under such conditions—3–4 wt % in relation to petroleum cont of the raw material—does not hinder continuous operation, being largely separable with the reactor product. Less coke is formed when activated C cat and H_2-carrier gas are used together, and *ca* ½ the 3·5% of S cont separates as H_2S. The petroleum, due to hard asphaltene cont, cannot be converted economically, even by conventional high-pressure hydrogenation at operating pressures >300 atm, into motor fuels. Mixed with tetralin efficient decomp to almost asphalt-free oils takes place at 70 atm. Under optimum conditions at 450° C, in presence of H_2-containing gas and activated C cat, approx 85 wt % asphalt is converted to oils with *ca* 0·2 wt % coke formation. With crude petroleum the dist composition of the products is reversed. Experiments with other thinners differing from tetralin in chem properties are discussed. R. T.

518. Refiners seek answers to puzzlers. L. Resen. *Oil Gas J.*, 3.12.56, **54** (83), 104.—A question–answer session on refinery problems at the recent W.P.R.A. meeting at El Dorado covers alkylation, fluid cat cracking, reforming, and miscellaneous other subjects. G. A. C.

HYDROGENATION

519. Hydrogen recovery and purification from refinery off-gases. J. T. Hugill and F. G. Kerry. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 324–7.—Hydrogen separation from hydrocarbon gases by low-temp fractionation was developed first in Europe many years ago. From the time Professor d'Arsonval of France extracted hydrogen from city gas flowing through a coil cooled by liq air, back in 1900, the chemical industry has been an insatiable consumer of hydrogen. That demand has been answered by the exploration of every possible source of hydrogen and by its recovery utilizing low temp fractionation.

For a great many years coke-oven gas has supplied the bulk of the hydrogen used by the chemical chemistry in Europe. Since the last war, reformed hydrocarbon gases and refinery off-gases have been exploited as large, cheap sources of hydrogen. Recently, however, Platformer gases rich in hydrogen, and found in great quantity, are becoming tremendously important in the hydrogen-recovery field.

Several plants are under construction which will use Platformer gas as a source of hydrogen. In fact, one will be in operation by the time this paper is presented. This paper covers some of the technical and engineering problems met in the handling of such hydrocarbon gases and what the future holds for these hydrogen-rich refinery gases as a source not only of ammonia, urea, and other fertilizers, but also for the chemical industry in general. (Authors' abstract.)

POLYMERIZATION

520. Compounding acrylate polymers for resistance to a diester lubricant. High temperature applications. W. J. Mueller and R. A. Clark. *Industr. Engng Chem.*, 1956, **48**, 982–91.—Petroleum base lubricants and hydraulic fluids are not satisfactory at the high temp (>350° F) encountered in present-day aircraft. Diesters such as di-*iso*-octyl sebacate

(turbo oil −15) have been found to satisfy the lubricating requirements, but they are plasticizers for rubber, particularly under high temp and oxidizing conditions, and consequently it has been necessary to develop rubbers suitable for use under these conditions.

Acrylate rubbers were known to have good oxidn and temp resistance, and these were used as a basis for compounding studies carried out to obtain a rubber which was also diester-resistant.

Ageing tests were carried out in the diester at 350° F and cpds which passed the test after 168 hr continued until 500 hr had been reached. In addition, 5 vulcanizing systems were investigated, the most promising results being obtained for a copolymer based on ethylchloroethyl vinyl ether (Hycar 4021) vulcanized with a triethylene tetramine–sulphur–tetramethylthiuram disulphide system. The stocks produced swelled least and were most efficient in maintaining hardness and tensile strength during ageing. A long curing time and, in some cases, tempering, were found to be beneficial to the ageing characteristics. The resistance to diester attack was also found to be influenced by the filler used, and one of the calcium silicate type (Silene EF) was found to offer the best combination of reduced swelling and cracking tendencies, and in addition the loss in tensile strength was negligible at high loadings. The use of plasticizers during the compounding does not appear to be advantageous, but the use of stearic acid in the proportion 1 : 100 as a lubricant was found to aid the process. Antioxidants such as "Agerite resin D" were not beneficial.

Other studies were made with a copolymer of ethylacrylate and acrylonitrile (Acrylon EA-5), and stocks were produced which had a greater resistance to swelling but which were very prone to cracking when compared to similar stocks prepared from Hycar 4021. D. B. S.

521. Coral rubber—a *cis*-1,4-polyisoprene. F. W. Stavely *et al.* *Industr. Engng Chem.*, 1956, **48**, 778–83.—GR-S type polymer rubbers are now extensively used for motor tyres, etc., but they are lacking in certain physical properties when compared to natural rubber. The more obvious of these deficiencies are high hysteresis, low gum tensile, and poor retention of physical properties, such as tensile strength, at elevated temp. "Coral" polymer rubber is similar chemically and structurally to natural rubber, and its properties have also been found to compare favourably. The process by which this type of rubber was prepared using a lithium metal cat at 40°–50° C is described. "Agerite resin D" was added to improve the oxygen stability. Coral rubber contains 93·8% *cis*-1·4- and 6% 3·4- structure compared to 97·8% and 2·2% respectively for Hevea rubber. The rubber was found to have a reduced tendency for oxygen absorption, no greater heat build-up than natural rubber, and also greater resistance to cracking of tyre treads. The tread wear on passenger and truck tyres was 95% of natural rubber wear. Other physical properties are discussed in detail. D. B. S.

522. Ameripol SN—a *cis*-1,4-polyisoprene. S. E. Horne, Jr., *et al.* *Industr. Engng Chem.*, 1956, **48**, 784–91.—Ameripol SN has been prepared from an isoprene monomer system using a Ziegler-type cat. The properties of this synthetic rubber are discussed and compared to Hevea rubber. I.r. spectra and X-ray diffraction data showed the molecular configurations to be essentially the same in both rubbers. Small quantities of lecithin and triethanolamine were added as buffer materials to help the curing properties, and the stabilized polymer formed produced vulcanizates in standard stocks showing physical properties, such as stress–strain and low hysteresis values, similar to those of Hevea rubber vulcanizates. The performance of tyres made with Ameripol-SN was compared with Hevea rubber tyres run in indoor, truck, and inter-city bus tests. D. B. S.

CHEMICAL AND PHYSICAL REFINING

523. What's ahead for desulphurizing? J. B. Smith. *Oil Gas J.*, 10.12.56, **54** (84), 109.—It is estimated that desulphurizing or hydrogen treating of petroleum stocks will amount to 10% by Jan 1957, and treating will increase to 32% and 36% in 1960 and 1965. G. A. C.

SPECIAL PROCESSES

524. Hydropretreatment of catalytic reformer feed. D. H. Stevenson and G. A. Mills. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 328–33.—The present trend in the petroleum industry toward higher octanes has made necessary the cat reforming of high-sulphur naphthas. However, cat reforming can be carried out most efficiently when little or no sulphur or other cat contaminants are present in the naphtha feed. Therefore, a hydropretreatment process has been developed, which is most efficient for removing cat reformer contaminants from feedstocks. The process is simple and economical because hydrogen produced in the reformer is used to treat the naphtha, which passes in sequence through the "guard" case, contaminant stripper, and reformer.

Results from a study of process variables are reported, which demonstrate that hydropretreating with Type 3 Houdriforming cat can be successfully applied to a wide variety of feedstocks, including virgin naphthas, thermal naphthas, and naphtha–kerosine cuts. Almost complete desulphurization is achieved at high space rates with any of these charge stocks, including those high in thiophene–sulphur content. (Authors' abstract.)

525. The Gulf HDS process for upgrading crudes and residues. J. McAfee, C. W. Montgomery, C. R. Summers, Jr., J. H. Hirsch, and W. A. Horne. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 312–23.—The Gulf HDS process is a moderate-pressure process which converts heavy residual fractions to lower-boiling dist products while simultaneously effecting substantial desulphurization of all fractions of the charge stock. The process involves the use of a rugged cat which maintains good activity even after repeated regeneration and in spite of the deposition of considerable amounts of metallic contaminants. During the development of the process in lab and 50-b.d. pilot-plant operations, a variety of charge stocks has been investigated, including numerous high-sulphur, low-gravity crude oils, a number of topped and reduced crudes, and several blends of reduced crudes with high-sulphur dist stocks. A description of the pilot plant and typical results are presented in this paper. Paralleling this experimental work, continuing economic studies of the process have indicated that the credits realized from applying the Gulf HDS process to certain crude oils and residues are appreciable and, in appropriate circumstances, justify the substantial investment involved. (Authors' abstract.)

526. Improving distillate fuels by Hydrofining. W. J. Zimmerschied, R. A. Hunt, Jr., and W. A. Wilson. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 308–11.—Dist from crude oils high in sulphur or aromatics content cannot be finished to high-quality fuels by conventional sweetening methods. Such treatments as solvent extraction or severe acid treating are necessary to reduce the sulphur content, remove the offensive odour, and improve the burning quality.

The Hydrofining of a dist from high-sulphur W. Texas crude oil improved its quality to that of Mid-Continent dist, with no loss of liq product. Desulphurization was essentially complete, the product was sweet, and the objectionable odour was eliminated. The burning quality was measured by smoke point and by a full-scale burner test. The smoke point, a measure of sooting tendency, was improved by means of Hydrofining. Combustion deposits in the burner test were markedly lowered. (Authors' abstract.)

527. Petroleum coke and its production. F. Sef. *Nafta (Yugoslavia)*, 1956, **7** (10), 301–7.—Describes industrial processes for the production of petroleum coke, *i.e.* delayed coking, Curran coking, continuous contact coking, fluid coking, and Hoechst continuous coking. The processes are reviewed on the basis of bibliography. The basic principles of the coking process and the structure of the petroleum coke are given. (Author's abstract.)

METERING AND CONTROL

528. Level indication and control. Anon. *Petrol. Times*, 21.12.56, **60** (1549), 1149.—3 novel methods of level indication are described and include capacitance devices, one using γ-radiation techniques, and a heat transfer method.

G. A. C.

529. Remote control of valves. Anon. *Petrol. Times*, 21.12.56, **60** (1549), 1151.—Details are given of motorizing units designed by Telektron (Gt. Britain) Ltd for remote control of all types of standard systems, including design of a small compact panel for same flexibility and sensitivity of valve adjustment as obtained by manual operation.

G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

530. Combustion of methane. E. Jones. *Nature, Lond.*, 1956, **178**, 1112.—For methane–oxygen mixtures the most reactive is a 2 : 1 ratio, the most easily detonated is a 1 : 1 ratio, and the most inflammable is a 1 : 2 ratio. These facts may be explained by postulating the following reactions:

2 : 1 ratio $CH_4 + (O + O) + CH_4 \rightarrow 2CH_3OH + 78$ kcal

1 : 1 ratio $(C + H_2 + H_2) + (O + O) \rightarrow CO + H_2 + H_2O + 77$ kcal

1 : 2 ratio $(CH_2 + H_2) + (O + O) \rightarrow CH_2O + H_2O + 78$ kcal

$CH_2O + O_2 \rightarrow (CO + H_2) + (O + O) \rightarrow CO_2 + H_2O + 135$ kcal

The energy released in detonation is much less than that generated by deflagration, and the violence of the detonation process therefore depends on the reaction speed, which in turn depends on the statistical frequency of encounters between the different species. H. C. E.

531. Drainage of liquid from surfaces of different rugosities. J. J. Bikerman. *J. Coll. Sci.*, 1956, **11**, 299–307.—2 hydrocarbon oils, one highly refined, were allowed to drain from stainless steel plates of 9 different roughnesses. It is deduced that the vol of oil remaining on the plate after t sec is prop to $t^{-\frac{1}{2}}$, and this relation is approx confirmed when the smoothest plates are used. On the rough plates a stagnant liq layer exists of thickness approx equal to the average height of the surface irregularities. It is claimed that this result: (1) refutes one of the proofs for the existence of long-range molecular forces; (2) confirms the hypothesis that the magnitude of electrokinetic phenomena is reduced by rugosity; (3) shows that roughness is a factor in measurement of adhesion; (4) provides a new method of measuring surface roughness.

H. C. E.

ANALYSIS AND TESTING

532. Structural groups of petroleum fractions. Communication I. Structural group analysis with infra-red spectroscopy. (In German.) G. Brandes. *BrennstChemie*, 1956, **37** (17–18), 263–7.—The spectroscopic method is based on the assumption that, in absorption at 1610 cm^{-1} each aromatic, and at 720 cm^{-1} each paraffin chain system is concerned. With spectroscopy the aromatic cont of extracts—unattainable by the *n–d–M* method—can be described rapidly with good reproducibility. Broadening the applicable range of the aromatic relation to *ca* 60%, the paraffin estimation must first be limited to the investigated range of 40–70% C_p with simultaneous reservation that the aromatic cont of the oil to be investigated is less than 25% C_A. Above this the paraffin absorption band generally cannot be evaluated. Applications are: petroleum fractions mol. wt. 290–500 (gas to cylinder oils) in concn range C_A = 0–60%, C_p 40–70%, if C_A<25%, compounded oils with the same concn ranges if additives do not absorb in the ranges in question. Extracts permit C_A estimation. 8 refs. R. T.

533. Contribution to knowledge of basici of unsaturated hydrocarbons and their complex formation with hydrochloric and hydrobromic acids at low temperatures. (In German.) E. Terres and M. Taghi Assemi. *BrennstChemie*, 1956, **37** (17–18), 257–63.—Investigation of 20 binary systems of unsaturated hydrocarbons with HCl and HBr is presented. Procedure is based on m.p. diagrams. Toluene system—50 mol % hydrocarbon—forms no stable cpd, it decomp at 30 mol %. With ethylbenzene small decomp occurs, with *iso*propylbenzene none. *Tert*-butylbenzene—despite high m.p.—forms a stable cpd at −71° C. Basic properties increase: toluene < methylbenzene < propylbenzene < *iso*propylbenzene < *tert*-butylbenzene. Colour changes—max depth at 50 mol %—accompany complex formation. M.p. diagrams of only 4 di- and tri-alkylbenzenes have been taken, others have too high m.p. *m*-Xylene and mesitylene at 50 mol % hydrocarbon show a clear max. *pseudo*Cumene shows only a kink, although it should be more basic than *m*-xylene. Mesitylene complex is the most stable. Basicity of di- and tri-alkylbenzene derivatives increases with increasing No. of substituents, influence of *m*-position is > *o*- or *p*-position. *p*-Cumene forms a complex with 2 mol HCl. Olefins with double bond can form complexes at lower temp. *cyclo*-Hexene alone forms a stable complex with ratio 1 : 1, at −109·7° C, octene-1, nonene-1, and decene-1 show only a weak kink. Trimethylethylene and 1-methyl*cyclo*hexene react with HCl, forming chlorinated hydrocarbons. Basicity is decene-1 < nonene-1 < octene-1 < *cyclo*hexene. Complex formation is assumed as a reciprocal reaction of π electrons of the double bond with the polar HCl mol. 23 refs.

R. T.

534. Determination of the viscosity–temperature relationship for crude oils with the Ultra-Viscoson. J. M. Howell and F. W. Jessen. *J. Petrol. Tech.*, 1956, **8** (9), 95–7.—Visc–temp relationships of various oils have been determined by the Bendix Ultra-Viscoson, which employs a vibrating probe excited by electrical pulses. Solutions of paraffin wax in kerosine were examined, and the break in the slope of the visc–temp plot was found to agree to within 3° C with the cloud-point as determined by the ASTM method. Similar breaks were observed when measurements were made on a series of crude oils which would not, because of their dark colour, permit visual observation of the appearance of a solid phase, which is the basis of normal cloud-point determinations. Hence the viscometric method may be of use in making cloud-point determinations.

The effect of asphaltic materials on cloud points was also examined. Small amounts of asphaltic matter lowered the cloud point, but larger amounts caused a rise. G. D. H.

535. Paraffin in oils from the Kriz and Sumecani fields, Croatia. D. Tarjan. *Nafta (Yugoslavia)*, 1956, **7** (10), 308–11.—The author has applied the method of fixing the cloud point in order to ascertain the content of solid paraffins in oils from the Kriz and Sumecani fields. He has found that this

method qualifies sufficiently these domestic oils, which reach the refineries with variable paraffin contents.

(Author's abstract.)

536. Auto-ignition of fuels in a constant-volume bomb. Effects of operating variables and fuel structure. M. A. Elliott, R. W. Hurn, and H. M. Trimble. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 361–73.—The ignition delays and minimum ignition temp of numerous pure hydrocarbons were determined in a constant-volume bomb at 250 p.s.i.g. and 650 p.s.i.g., at 8 temp between 500° and 1390° F. Ignition-delay measurements were also made on 2 secondary diesel reference fuels. At low bomb temp, ignition delay decreased with increasing fuel–air ratio toward stoichiometric, but at higher temp it increased. Increased pressure shortened ignition delay above 800° F, but increased it for many fuels at temp approaching the minimum for auto-ignition. The temp corresponding to zero pressure sensitivity depended on mol structure and fuel–air ratio. Ignition delay usually decreased with increasing temp, but this behaviour varied widely for different hydrocarbon structures. The relative ease of ignition of *iso*-octane and *cyclo*hexane varied with temp. Branched-chain hydrocarbon fuels were apparently less temp-sensitive than paraffins or naphthenes. Ignition delay decreased with increasing chain length (paraffins, olefins, and alkylnaphthenes), or an addition of a methyl group to a naphthene or saturation of an olefinic bond. It increased markedly as the degree of branching increased. The effects of structural changes varied markedly with test conditions. The ignition delays of triptane and *iso*-octane increased with temp between fairly narrow limits. With some exceptions, the minimum ignition temp were in the relative order to be expected from ignition-delay data. A unique correlation of C.N. with ignition-delay measurements for fuels of widely varying structure could not be obtained. The various fuels differed markedly in their rates of heat release.

(Authors' abstract.)

537. A survey of hot fuel-handling problems—a report of trouble-spot surveys conducted during the summers of 1953 and 1954. D. P. Heath, J. G. Moxey, Jr., and G. Way. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 374–90.—Extensive surveys of hot stalling, hot starting, and vapour lock were made by the Volatility Group of the CRC Motor Fuels Division in various parts of the U.S.A. during the summers of 1953 and 1954. The incidence of these problems varied with ambient temp, type of operation, soak period involved, altitude, mountain grade, wind velocity, and other factors.

At one high-speed turnpike location the incidence of hot stalling, hot starting (6 sec or more), and vapour lock was approx 12%, 25%, and 25%, respectively, at 105°–110° F. The incidence of starts requiring 3 sec or longer at this location was 60–70% at 90° F and high temp.

In some areas no trouble of any kind was observed up to 95°–100° F. In others, the incidence of hot stalling, hot starting, and vapour lock was zero to 3%, zero to 15%, and zero to 3%, respectively. At 4 locations which involved either a combination of city traffic and highway driving or city traffic entirely, the incidence of stalling was considerably lower and less closely related to temp than at turnpike or highway locations. The vapour-lock characteristics of a given car model did not necessarily correspond to its hot-stalling or hot-starting characteristics.

The procedure used in the 1954 survey is detailed in an appendix, and numerous tables and graphs are given.

(Authors' abstract.)

538. Incentives for precise test methods: the case for a new basic knock-test unit. M. R. Morrow. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 391–400.—Significant improvements in the precision of lab knock-test methods could reduce the cost of motor gasoline produced in the U.S.A. by $12,000,000/year. ⅓ of this saving can be realized by multiple testing to improve the precision of results. However, significant improvements in the test methods are necessary to obtain the remaining $6,000,000/year. Customer complaints caused by wide variations in the quality of the product would be reduced or eliminated, and at least a part of the foregoing saving could be passed on to the customer.

For aviation fuels, supplies could be increased and costs reduced if more precise test methods were available. The effects of improvements on these products have not been worked out in detail, but a 10% increase in max production of grade 115/145 fuel is predicted to be possible on the basis of work in the laboratories of Humble Oil and Refining Co. With more precise test methods available, it also might be possible to reduce specification requirements, *e.g.* requirements for grade 115/145 might be reduced to 110/140.

Research Division I of ASTM Cttee D-2 is working to accomplish desired improvements in the precision of knock testing. To obtain significant improvements in a short period of time (from 2 to 3 years), the work load will be considerably higher than normal. (Authors' abstract.)

539. Use of the " oil spot " test for engine lubrication control. R. Courtel *et al.* *Rev. Inst. franç. Pétrole*, 1956, **11**, 1269–97.—One drop hot oil is placed on 6-cm dia ashless (*e.g.* Whatman No. 1) filter paper, using either glass rod or (for road tests) dip stick and examined after spreading (1–2 hr or more). Detailed discussion given of appearance of spot, together with 81 photographs of spots (and 8 photomicrographs of oils) obtained both in bench (Petter and Caterpillar) and road tests on diesel and petrol engines using straight and detergent (Mil-L-2104-A and Supp. 1) oils. Although considerable experience is necessary for correct interpretation of test, it can given valuable guide to condition of both oil and engine.

V. B.

540. Demerit system for rating the performance of lubricating oils and fuels in reciprocating internal combustion engines. R. Tourret and R. W. Bale. *J. Inst. Petrol.*, 1956, **42** (394), 292–7.—As there is no correlation between performance ratings of fuels and lubricants in the various test engines available, the Admiralty Oil Laboratory has devised a system which it is hoped will be suitable for all test engines.

The proposed method, which is based on the best features of the U.S. Navy, Caterpillar, and Petter methods, is outlined and compared, and the authors hope it will serve as a basis for discussion. 2 refs. C. B.

541. How oil volatility and additives affect engine octane requirement. F. S. Wood and C. C. Colyer. *Oil Gas J.*, 24.12.56, **54** (86), 69.—Oil used as lubricant influences octane requirement of a motor, and the volatility of the base oil, organic components of the detergents, and oxidn inhibitors have a direct bearing. Tables show lab tests on various oils, and results are given on field tests on 2 10W-30 S-1 oils.

G. A. C.

542. Temperature and humidity control in new gas laboratory. Anon. *Chem. Engng Min. Rev.*, 1956, **49** (1), 17–19.—A specially-equipped lab for Lurgi gasification plant at Highett works of Gas and Fuel Corporation, Morwell, features interesting temp and humidity control. Const cal. val. and opt. eff. require continuous quality control in blending brown-coal gas with refinery tail gas, water gas, and black-coal gas. Cal. val. of refinery gas used to boost that of brown-coal gas may vary by 400 B.t.u. in 24 hr. For Corporation gas statutory min is 500 B.t.u. Maintenance of const thermal val is economical. Atm variations adversely affect accuracy of recording instruments. Instrumentation is described for monitoring cal. val. of blended and primary gases, temp and humidity control by air conditioning, t. cal. val. determination. Layout includes sp identification colours on all gas pipes.

R. T.

543. Gas chromatography. Anon. *Oil Gas J.*, 17.12.56, **54** (85), 126.—Phases are given of the operation of gas chromatography for rapid accurate analysis for refining, natural gasoline, and petroleum chemical plants. Subjects dealt with include natural gas and gasoline analysis, role of column packing materials and carrier gases, sample introduction, detectors and recorders, operating conditions and technique, an automatic instrument for hazardous areas, new developments, and future applications. G. A. C.

544. New detector for vapour phase chromatography. J. Harley and V. Pretorius. *Nature, Lond.*, 1956, **178**, 1244.—The instrument comprises a small Pt disk cathode and a W wire anode forming one arm of a Wheatstone Bridge, which is balanced with carrier gas at a pressure low enough to produce normal glow discharge. Cpds in the carrier gas eluted from a chromatographic column cause a voltage change which can still be measured when the amount present is 10^{-12} mol. As an example the analysis of 10^{-10} mol of petroleum spirit (b.p. 40°–60° C) is given. H. C. E.

545. Constitution determination of ring-rich products of coal extract hydrogenation. (In German.) J. J. T. M. Geerards and H. I. Waterman. *BrennstChemie*, 1956, **37** (17–18), 267–8.—Ring No. of 14 coal extracts—converted into fully saturated oils by hydrogenation with Ni-kieselguhr cat at 280°–290° C and 200 atm pressure—are determined by calculation from 2 accurately determinable physical magnitudes n_d^{20} and d_4^{20}. Tabulated results show remarkable agreement with those from other methods. Graphic-statistical methods can be used for these oils. 9 refs. R. T.

546. A laboratory test to evaluate the shape and surface texture of fine aggregate particles. H. M. Rex and R. A. Peck. *Publ. Rds, Wash.*, 1956, **29** (5), 118.—A test is described developed by the Physical Research Branch of the U.S. Bureau of Public Roads using simple apparatus, by which lab studies may be made of bituminous mixtures and surface characteristics of sands in the field with respect to specified requirements can be achieved. G. A. C.

GAS

547. Valuation of gas reserves. R. E. Davis and J. M. Wege. *J. Petrol. Tech.*, 1956, **8** (9), 18–21.—The cash generated annually from the production and sale of gas from a proven and developed gas reserve has been calculated, based on estimates of annual output, income after royalty, direct expenses and overheads, depreciation, depletion, and income tax. Further computations give the present worth of the cash to be generated, assuming discount factors of 6, 8, 10, and 12%. Various values are assigned as a sale price for the property, and with the value of the fixed assets to be depreciated known the pay-out time and the cash income after pay-out are calculated.

Comparable calculations are made for the same property, assuming that 40 of the 164 locations required to be drilled at the time of the sale. G. D. H.

548. Developments in the gasification of combustible solids in Great Britain. F. J. Dent. *Riv. Combust.*, 1956, **10** (11), 787–802.—The paper describes developments in water gas manufacture, producer gas manufacture, and in processes for the complete gasification of coal. The developments in water gas manufacture include the use of high blast pressure to increase output, of preheated air and steam supplies to increase efficiency, and of heavy oils for enrichment. In producer gas manufacture, the trend has been towards a greater use of automatic plants, and there are now control systems to maintain steady gas quality during variations in load. Processes for complete gasification have not yet found much application, but in view of the shortage of coal and a likely deterioration in its quality, they have been the subject of extensive research. Investigations have concerned fluidized processes, pressure processes, the synthesis of methane, and hydrogenation of carbon and petroleum. Further work is indicated. (Author's abstract.)

549. Conditioning gas for transmission. A. L. Kohl and F. C. Riesenfeld. *Pipe Line Ind.*, 1956, **4** (5), 54–5.—Pt II deals with new systems for minimizing chem losses, corrosion, and steam consumption. High capacity solid adsorbents and more conc triethylene glycol in liq dehydration plants are new developments. 17 refs. R. T.

550. Recent knowledge on economical utilization of gas purifying masses in dry gas desulphurization. (In German.) P. Michaelis. *BrennstChemie*, 1956, **37** (19–20), 323–31.—Mass consumption (costs) and enrichment (proceeds) stand in mutual relationship. In studying equilibrium conditions only gas desulphurization and mass enrichment are essentials. Gas desulphurization is considered as a cat H_2S oxidn whose equilibrium position is given from mol concn of reaction partners and reaction pressure. Increase in reaction velocity by increasing reaction temp comes—with regard to the exothermic character of the transposition—only into consideration in order to modify the const decline of the activity of the mass, which is conditioned by the S reception. Lowering the activity—in the rough gas purification—limits the degree of desulphurization and mass enrichment; in the fine purification it requires observance of the crit S concn. The necessity to follow both gas desulphurization and mass enrichment at the same time, assumes an adequate S concn fall in the introduced mass, and therewith a reaction path which guarantees a suitable contact period and flow rate of the gas. The conclusions from the developed theory are in accord with experimental results and operational experience. 9 refs. R. T.

551. Pipeline mileage being doubled as Russia strains to expand its natural gas industry. H. F. Lippitt. *Oil Gas J.*, 31.12.56, **54** (87), 178.—The natural gas supply position in Russia is reviewed. Some 300 billion cu. ft. of gas are now transported annually, but the 1956–60 5-year plan calls for doubling gas pipeline. G. A. C.

ENGINE FUELS

552. Performance of high-speed diesel engine fuels. J. G. Withers. *Gas Oil Pwr*, 1956, **51**, 314–20.—The various factors governing automotive diesel performance are studied with reference to the properties of the fuel:

Cold Starting: Ease of pumping will not be affected by visc provided that the temp is <8° C below the pour pt. Low cloud pts (>3° C below starting temp) are necessary if the filters are not to be blocked by wax particles, thus causing fuel starvation. Volatility and high C.N. are necessary for ease of ignition of the fuel, and since these can be correlated with sp. gr., decrease of the latter will result in a decrease in min starting temp.

Fuel Ignition is affected by solids in the fuel and by visc; if this is too high the spray will be coarse and the combustion inefficient. A range between 2·0 and 7·5 cS (100° F) is recommended.

Combustion Knock is decreased by increase in C.N.; under idling conditions high volatility may become important.

Fuel Consumption and Power Output depend on net calorific value. Changes in in sp. gr. have only a minor effect.

Exhaust Smoke is not greatly affected by the fuel. Blue smoke (unburned fuel) may be due to fuel of too high sp. gr. Black smoke (incomplete combustion) may be increased by decrease in C.N.

Carbon Deposits are markedly decreased by increased volatility of the fuel, as measured by % distilling to 350° C. There is a linear correlation between sp. gr. and weight of

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nozzle deposit. C.R. (Conr) value shows little correlation, but should not exceed 0·1%.

Piston and Cylinder Deposits and Wear are largely controlled by the lub oil, although the presence of S in the fuel is deleterious. H. C. E.

553. Fuels for high performance engines. J. G. Withers and H. F. Eatwell. *Auto. Engr*, 1956, **46** (13), 521.—The 100-octane motor fuels now available in the U.K. should enable the automobile industry to build engines with C.R. up to 10 : 1. The 100-octane fuels give not only high anti-knock performance but their volatility, stability, and engine cleanliness are equal to or better than gasoline already available. D. K.

554. Increased life for gas turbine combustion systems burning residual fuel. R. W. Macaulay and C. M. Gardiner. *Gas Oil Pwr*, 1956, **51**, 293.—General Electric gas turbines employ a combustion chamber in which 4 overlapping liner sections with annular gaps each admit cooling air along the following section. The liner life was found to be rather short, and the liner had to be redesigned.

Also the fuel nozzles required frequent cleaning, and a new type was devised. Fuel is supplied through rather large passages into a central chamber, where it is picked up by a blast of " primary swirl air." Near the exit hole the stream meets high pressure " secondary swirl air," which atomizes the fuel. H. C. E.

555. Standard gas turbine to burn a variety of fuels. G. B. Fielden, J. D. Thorn, and M. J. Kemper. *Gas Oil Pwr*, 1956, **51**, 295.—General description of a 750–1000-kW gas turbine is given. The combustion chamber is separate from the compressor and turbine units, so that accessibility and maintenance are simplified. An abrupt change of direction is utilized to form vortices which assist in mixing the air and fuel, and also provide internal wall cooling. The unit now has good combustion efficiency combined with low pressure loss when diverse fuels such as natural gas, light dist, residual fuel, sewage gas, furnace gas, and coal tar are used.

The preferred method of lighting the flame is with the use of a liquefied petroleum gas and a low energy electric spark. H. C. E.

556. Fuel oil additives to suit the individual user. N. Seely. *Fuel Effic.*, 1956, **4** (39), 686–7.—The author is concerned with the problem which arises from the fact that no 2 consumers have the same additive requirements. A good additive consists of combustion cat, inhibitors, detergents, solvents, etc., and can be split into 2 parts, one containing the oxidants and the other the antioxidants, detergents, inhibitors, etc. One firm has conducted extensive trials with additive concentrates, allowing the customer to formulate additives to meet his own particular requirements. This enables additive blends to be altered according to prevailing conditions and increases overall efficiency. C. B.

GAS OIL AND FUEL OIL

557. A " new look " at heavy fuel oils. J. O. Collins and W. T. Knox. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 431–7.—For many years the price of heavy fuel oil has been approx equivalent to that of bituminous coal, and has frequently been less than the price of crude oil. The yield of heavy fuel oil from crude in U.S. refineries has decreased from *ca* 25% in 1946 to an estimated 15% in 1955. The growing use of fuel oil reduction processes in U.S. refineries has stimulated a new survey of the quality and uses of heavy fuel oils. Fuel reduction processes have tended to concentrate undesirable constituents—such as ash, sulphur, and sediment—in the heavy fuel oil, and have made maintenance of quality more difficult.

Proper design of combustion equipment can minimize problems associated with heavy fuel oil combustion. However, modern power-generating equipment has also placed more critical demands on heavy fuel oil through higher operating temp. Ash deposits in air heaters, slagging of refractories, and high-temp corrosion of metals have been related to the vanadium and sodium content of fuel oil ash. Sulphur can cause low-temp corrosion, as well as contribute to ash deposits. To minimize these problems, the use of additives and fuel washing have been found economical in some cases. The ultimate solution will require close co-operation between the designers, operators, and oil refiners.

(Author's abstract.)

LUBRICANTS

558. Axle gear lubricants. The post-war trends in the U.S.A. Anon. *Auto. Engr*, 1957, **47** (1), 26.—The possible causes of scoring of gears and its means of prevention are discussed. A table giving data on the recommendations for axle lubrication of American cars shows how these have varied in the last 4 years. The type of lubricant which will be most effective is considered. It is suggested that as the oils at present available in the U.S.A. have in some degree been inadequate, it is necessary to have tests which would define a more suitable quality level. Lubricants have been formulated which pass tests which simulate severe operational levels, but little data is available on them. D. K.

559. Preliminary investigation of minimum oil feed rates for fluid-film conditions in journal bearings. D. D. Fuller and B. Sternlicht. *Trans. Amer. Soc. Mech. Engrs*, 1956, **78** (6), 1193–200.—Kingsbury and Need's solution of the general Reynolds hydrodynamic equation is used to obtain an equation for the analysis of side flow in a journal bearing. A test machine is described and used to obtain coeff for this equation, and the value of the minimum oil feed rate for the journal bearing under test is derived. It is expected that these coeff will be applicable for a wide range of bearing sizes, but so far only qualitative corroboration has been obtained. 6 literature refs and 2 pages of discussion. C. B.

560. Methods of studying the surface structure of solids. F. P. Bowden. *J. Coll. Sci.*, 1956, **11**, 555–64.—Among the methods discussed are those suitable for examining the effects of frictional wear of metallic surfaces. They include use of a stylus, taper sectioning, multiple beam interference, and reflection electron microscopy. The advantages and limitations of each method are discussed.

The chain length of hydrocarbons adsorbed as a monolayer on a surface has been measured by the multiple beam interference method. H. C. E.

561. Chain lubrication—some new techniques. A. Cheney. *Mech. World*, 1956, **136** (3449), 534.—Methods are indicated which have been successfully used to combat the adverse conditions often encountered in chain lubrication. The use of solid lubricants, graphite, and molybdenum disulphide is particularly considered. D. K.

562. Control of bacterial spoilage of emulsion oils. E. O. Bennett. *Soap, N.Y.*, 1956, **32** (10), 47; **32** (11), 46.—Bacteria can oxidize emulsion components, rendering the cutting fluid useless. Ways in which bacteria may enter the oil are reviewed, together with types of bacteria encountered. Frequent pasteurization of emulsion has been recommended to control the bacteria, but this is expensive, and unless all contaminated material is removed is ineffective within a few days. Inhibitors are frequently incorporated in the cutting oil to prevent growth of micro-organisms, and the work that has been done in this field is described. Several procedures for testing bacterial inhibitors in cutting oils, together with

their disadvantages, are discussed. It is concluded that unless bacterial inhibitors for emulsion oils are used in conjunction with efficient industrial hygiene they cannot be effective. A table is given showing the cpds that are effective against micro-organisms in emulsion oils, the concn in p.p.m. which was tested, and a reference to the work. D. K.

563. Water separability from mineral oils as a contribution to their evaluation. (In German.) H-W. Thoenes. *Brennst-Chemie*, 1956, **37** (19–20), 336–41.—Occurrence and effects of H_2O in mineral oils in industry—steam turbines, oil circulation, etc.—are discussed. Evaluation of the oils according to emulsifying degree specified in standards, *e.g.* DIN 51591, does not correspond to relationships in practice. The ability of oil to separate again from H_2O as quickly as possible (H_2O separability) is of greater interest. A new testing procedure measures this ability—in the steam-treated oil—by following the fall of the H_2O phase in the oil layer in a definite apparatus under strictly fixed conditions. The time measure is a criterion for the H_2O separability of the oil. The apparatus is illustrated. R. T.

BITUMEN, ASPHALT, AND TAR

564. Results with injection procedure in bituminous road construction. (In German.) J. Oberbach. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (8), 295–8.—A process is described for stabilizing road foundations and substructures without breaking up black surfaces. In heavy traffic, especially on a yielding foundation, the braced pack layer can at first capture alternating stresses elastically. However, in places of max vibration, the substructure is compressed, and cavities form under the pack layer. On overloading the bridges formed, by heavy motor lorries, the pack layers break out, the bitumen cover fractures, and H_2O penetrates. Faults are felt out and the cavities filled with injections. By compression, the cavities in the gravel stratum, pack layer, and foundation are bound into a plate, and foundation defects are bridged over better. This compound body—on account of its greater mass—resists traffic effects better, and the track durability is improved. Such a stabilized track is the best foundation for a sealing coat. Successful applications are described. R. T.

565. Efficiency of adhesive additions in bitumen and cutback bitumen as binders in road construction. (In German.) T. Temme. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (8), 298–300.—Adhesion of cutback bitumen and adverse effects of H_2O or hydrophilic stones are discussed. Basic and acid stones used in road construction differ in chem behaviour. It follows that they behave differently towards bitumen binders, with or without adhesives. Many industrial adhesives tested are suitable for one stone type but not for both. A mechanical mixing test and a sieve test which permit reliable evaluation of the eff of various adhesives contemplated for a given purpose—with acid or basic stone—are described and illustrated. The binders must also resist decomp under thermal effects, *e.g.* 65°–80° C, in storage tanks and 120° C on application. All relevant test results are tabulated. R. T.

566. Bituminous materials, their processing and use mirrored in recent German patent literature. (In German.) H. Hoffmann. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (9), 356–7.—Continuation of full descriptions of patents with illustrations. R. T.

567. Heat resistance of adhesive additions in cutback bitumen. (In German.) T. Temme. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (10), 375–7.—Methods given refer to testing adhesives—in quantities from 0·25–4%—in cutback bitumens. Figures presented give only comparison of relative heat resistance in contrast to original effect, and give no foundation for general evaluation of eff of various adhesion improvers for cutback bitumen towards stone. Effects of adhesives—mostly N-containing—on cutback bitumens are compared by tests used in the U.S.A. R. T.

568. Effect of using silicones in the laboratory test for recovering bitumens and in the distillation test for cutback bitumens. E. H. Green. *J. Inst. Petrol.*, 1956, **42** (394), 298–9.—The paper shows that the use of silicone grease to lubricate ground glass joints in bitumen recovery apparatus leads to softening of the bitumen. It is also shown that the addition of a silicone anti-foaming agent to cutback bitumen prior to the distillation test, IP 27/53, retards the evaporation of flux oil, and hence gives a softer residual bitumen. 7 refs. C. B.

569. Design of coast protective structures with asphalt. (In German.) F. F. Zitscher. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (9), 340–4.—Progress in use of asphalt in coast protection from 1945–46 in Holland and 1949 in Germany is described. Locations of repairs, procedure, and composition of mixtures used are discussed with supporting drawings. R. T.

570. Diluted emulsions for flexible base. T. K. Wood. *Rds & Str.*, 1956, **99** (12), 138.—Diluted emulsified asphalt has been successfully used in Texas for controlling dust. Better moisture retention and better compaction has been attained with a saving in sprinkling and other costs, very little additional equipment being required. G. A. C.

571. Composition of lignite-tar pitches. (In German.) E. Gundermann. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (10), 378–82.—The composition of 3 lignite-tar pitches is investigated by decomp with selective solvents and pptn with sp media. Lignite pitches of different origin vary in % composition but not in qual composition. Macrocrystalline *n*-paraffin cont has a stiffening effect on many lignite pitches. The pitches contain *n*-alkanes and noteworthy amounts of alicyclic cpds with high *n* from which higher membered alicyclenes, di-tri-etc.-*cyclo*paraffins (C_nH_{2n-2}, C_nH_{2n-4}) with partly paraffinic, partly olefinic side chains, are presumed present. Isolated *n*-paraffins have b.p. 45°–67° C, non-paraffins lower. These hydrocarbons are semi-liq or liq. The pitches contain resins and high-mol infusible substances somewhat similar to petroleum bitumen. R. T.

DERIVED CHEMICAL PRODUCTS

572. Hydrogen—its markets and potential uses. R. L. James. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 291–3.—Outlets for hydrogen from cat reformers will continue to be more important in uses not associated with carbon monoxide than in uses which do involve carbon monoxide. The largest such use is in ammonia manufacture. However, exploitation of hydrogen for ammonia is complicated by the existing and growing overcapacity to produce. Although demand for fixed nitrogen will continue to expand, capacity is growing more rapidly. Therefore, new ammonia plants should be predicated only on specific economic advantages, and markets are expected to be highly competitive. Hydrogen for hydrogenating fats and organic chemicals offers smaller markets than ammonia, and opportunities are not widespread. The use of hydrogen in metal reduction will grow, but the present scale of operation is small.

Markets for hydrogen associated with carbon monoxide are limited primarily to reactions requiring supplemental hydrogen, in addition to that produced from partial oxidn or water-gas reactions of hydrocarbons. Development of new uses for hydrogen in the form of synthesis gas will involve uncovering economic sources of carbon monoxide independent of those in which hydrogen is generated simultaneously.

Utilizing the large volumes of hydrogen produced in cat reformers may best be accomplished through the development

of new products. Phosphine and coal-hydrogenation products are possible new uses, and others could probably be obtained through formal research programmes.
(Author's abstract.)

573. Hydrogen from catalytic reformer off-gas. C. Pfeiffer and H. J. Sandler. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 294–307.—The cat reforming of petroleum naphtha for motor gasoline or aromatics production yields, as a by-product, an off-gas rich in hydrogen. A comparison has been made of the more promising methods available for the production of high-purity hydrogen or ammonia from such cat reformer off-gases. Particular emphasis is placed on recovery of the hydrogen for ammonia production. Off-gases from actual naphtha reformer operation are used as feed gases in the study. Typical gas compositions containing from 77·7 to 94·2% of free hydrogen were chosen to cover the expected range of normal reformer operation. The processes considered are: (1) low-temperature separation; (2) steam reforming; (3) partial oxidn; (4) reforming with 95% oxygen; (5) reforming with enriched air; (6) oil scrubbing followed by steam reforming.

3 plant designs were made for each hydrogen recovery process in order to utilize 3 separate off-gas feed compositions. Thus the completed study covers the expected range of reformer off-gas composition for each of the 6 processes. Cost estimates, operating requirements, and unit production costs are developed for each case.

Low-temp separation is shown to be the most economical method to produce ammonia synthesis gas from refinery cat reformer off-gases in the composition range which has been studied. (Authors' abstract.)

COAL, SHALE, AND PEAT

574. Relationships between volatile constituents of coal and coking products. (In German.) A. Haarmann. *Brennst-Chemie*, 1956, **37** (19–20), 301–10.—The process and apparatus are described in which 80 coals are investigated. Yield and composition of hydrocarbons depend on quantity of volatile constituents, carbonization degree, petrographic coal structure, temp—in which final coking temp and heating rate play a part—on residence of hydrocarbons in the coking chamber under heat effects. Temp changes and long residence must be avoided; this is possible only in lab apparatus. Location of O_2 of the coal in coking is investigated. H_2S formation from S cont of coal is dependent on disulphide cont and quantity of volatile constituents. The genesis of various cracked products is referred to the coal model of Huck and Karweil. Abundant charts. 19 refs. R. T.

MISCELLANEOUS PRODUCTS

575. Manufacture of butyl rubber. M. Moulin. *Chim. et Industr.*, 1956, **75**, 746–53.—Brief discussion of structure and properties, manufacture is described with aid of schematic flow diagrams. 4 stages: (1) extraction of *iso*butylene (by 65% H_2SO_4); (2) extraction of isoprene (by extractive dist with aq acetone); (3) copolymerization of isobutylene with 1½–3% isoprene at *ca* −100° C (liq C_2H_4 refrigeration) using 0·1% $AlCl_3$ as cat and CH_3Cl (in which butyl rubber is insol) as inert diluent, 1% Zn stearate is added to prevent agglomeration, and phenyl-β-naphthylamine as anti-oxidant; (4) finishing treatments (drying, homogenizing). Mol. wt. (315,000–505,000) of product is variable and depends on reaction temp, *iso*butylene concn, presence of extraneous matter; controlled by visc (Mooney) at 100° C (38–>71). Vulcanization rate increases with unsaturated content (0·6–2·3%). (*cf.* Abs. **489**, 1956). V. B.

576. New thickener for glycerine. L. Cohen. *Soap, N.Y.*, 1956, **32** (11), 42; **32** (12), 50.—Carbopol 934, developed by B. F. Goodrich Chemical Co, is a high mol. wt. polymer containing a large percentage of carboxyl groups. The preparation and properties of glycerine and glycerine–water soln containing Carbopol 934 are described. The improved visc of glycerine suggests many new applications and improvements in current ones. Carbopol-thickened glycerine reduces the variation of visc with temp. The advantages of glycerine–Carbopol lubricants for various applications are considered. The cosmetics in which glycerine–Carbopol mixtures might be used are also discussed. D. K.

577. Solvent–detergent combination products. Anon. *Soap, N.Y.*, 1956, **32** (10), 79.—Solvent–detergent combinations can be more effective than detergents alone. Experiments have been made with tall oil and Teepol, a secondary alkyl sulphate; this combination gave a solution in the wash liquor. For some purposes an emulsion of solvent in the wash liquor is required and a mixture of Teepol 100 parts, tall oil 50 parts, and xylol 10 parts, or Teepol 100 parts, tall oil 50 parts, IPA 10 parts, and water 10 parts is suitable. The method of sulphonation of dodecyl benzene is described. The production of solvent–syndet combinations from sulphonic acid is also discussed. D. K.

CORROSION

578. Use of organic corrosion inhibitor in refining processes. C. Fiske and P. Mernitz. *Corrosion*, 1956, **12** (7), 350–4t.—Conventional NH_3 injection to a pH of 8 or more in the receiver waters had provided inadequate protection to the usual sites of aggressive corrosion in the crude and synthetic crude fractionators, admiralty metal exchanger bundles, and depropanizer overhead lines.

6–8 p.p.m. of the organic inhibitor, together with NH_3 injection to a pH of 6·5–7·5, was found to reduce corrosion appreciably, while savings of NH_3 have about balanced the cost of inhibitor. W. G. R.

579. Tubing of N.80 special steel, manufactured in France to resist corrosion by the H_2S-rich gas of Lacq. L. Cauchois, J. Didier, and E. Herzog. *Rev. Inst. franç. Pétrole*, 1956, **11** (5), 573–83.—Production of gases containing H_2S creates various serious problems in deep high-pressure wells. Corrosion and fracturing of tubing may be serious. Various investigations show that atomic hydrogen released as a result of corrosion leads to brittleness.

The Lacq gas contains 15% H_2S and 6% CO_2, and the producing formation is 3500–4000 m deep. In well Lacq 3 a blow-out occurred as a result of fracture of the drill-pipe, and there was also fracture of the casing. A tool joint failed after only 2 days in the gas.

Various tests and investigations of steels in corrosive media are described, and the results showed that steel APS 10 M4 was superior to N.80. Data for other steels are also given.

Well Lacq 102 has 7-inch tubing at 3821 m, and 4-inch N.80 6·5 lb/ft casing was set on a Baker packer at 3800 m, with 2⅜-inch N.80 (APS 10 M4) 4·7 lb/ft tubing inside. The space between the 4-inch and 2⅜-inch tubing was filled with gas oil mixed with Kontol, under pressure. Production of gas proceeded for 6 months, after which the tubing was extracted for examination and found to be in good condition. The same type of steel is to be used in other Lacq wells.
G. D. H.

580. Application of cathodic protection to 48 well casings and associated production facilities at Waskom field. G. L. Doremus, W. W. Mach, and J. J. Lawnick. *Corrosion*, 1956, **12** (8), 415–21t.—A multiple rectifier installation provided all

the current for 75% of the wells, including all the coated lines, an appreciable portion of the bare oil gathering lines, and most of the production storage tank bottoms in the field. Magnesium anodes were used alone or in supplement with rectifier drainage for the remainder.

In addition, a rectifier–graphite anode system was installed for protection of an emulsion treater and brine-handling equipment associated with a water flood project in the field.

W. G. R.

581. Organic inhibition. Corrosion control and petroleum. Anon. *Corrosion Tech*, 1956, **3** (8), 259–60.—Cationic polar mol are outstanding in resisting passage of moisture to metal surfaces and escape of corrosion products already formed. Certain quaternary ammonium salts of fatty amines (concn 5 p.p.m.) are claimed to give 95% protection. Attempts to check corrosion in an oil well require assessment of all relevant conditions. This permits classification into sour and sweet crude corrosion and gas condensate corrosion. Sour crude—S cont *ca* 0·5%—is extremely corrosive, being produced usually with a brine. *Ca* 80% sour crude wells require inhibitors, *e.g.* cheap. effective N-tallow propylenediamine chloride cut with crude oil, and injected into the well annulus at the rate of 1 pt/100 gal produced oil. With di coco-dimethylammonium chloride (Arquad 2 C), tests on steel plates showed reduction in pen/year from 93 to 91%. In well flooding pumping troubles were traced to sulphate-reducing bacteria—immune to conventional inhibitors, but destroyed by Arquads. Arquads $S\text{-}_2C + T\text{-}_2C$ (concn 6 p.p.m.) completely inhibit growth of sulphate-reducing bacteria and algæ in fresh-water systems. Arquad $S\text{-}_2C$ is effective against algæ, from the U.S.A. corrosion reduction *ca* 95% is reported. Injection of 10 p.p.m. of Armeen C into a casinghead petrol condenser in the U.S.A. in which small amounts of H_2O, traces of H_2S, and 1–2 p.p.m. CO_2 caused serious corrosion shows corrosion reduction > 97%, throughput increase > 20%, and condenser life increase at least 8·5 years. R. T.

582. The effects of contamination by vanadium and sodium compounds on the air-corrosion of stainless steel. G. W. Cunningham and A de S. Brasunas. *Corrosion*, 1956, **12** (8), 389–405t.—The progressive addition of sodium sulphate to the vanadium contaminant indicates that the most corrosive mixture is approx 20% sodium sulphate. The survey of the melting temp of various mixtures shows no direct correlation to corrosive behaviour. However, the unusually high oxygen solubility in the molten contaminant containing 20% sodium sulphate may be responsible for its unusually high corrosiveness.

Additions of CaO, SrO, and C were particularly effective in reducing the intensity of the attack, the effectiveness of this last being restricted to short intervals during which it became oxidized. W. G. R.

583. The effect of purification of commercial sulphonates on their corrosion-stain property. M. C. Muffley, — van Hong, and D. Bootzin. *Corrosion*, 1956, **12** (8), 411–14t.—Experiments were conducted to determine whether the staining characteristics of commercial sulphonates, used in the preparation of corrosion preventive lub oils, could be eliminated by purification and to identify the material causing the stain.

An extraction procedure produced a sulphonate that caused less staining than the original, and it was found that water-soluble sulphonates and inorganic salts were responsible for staining. W. G. R.

584. The effect of iron in galvanic zinc anodes in sea water. R. B. Teel and D. B. Anderson. *Corrosion*, 1956, **12** (7), 343–9t.—Sharp decreases in the current output of zinc galvanic anodes in sea water are attributed to the increase in the electrical resistance and tenacity of the corrosion product films which form on the anode's surface. This is influenced largely by the amount of iron present as impurity; it should be kept below 0·0015% for best results.

W. G. R.

585. Zinc anodes provide long life design. C. W. Ambler. *Oil Gas J.*, 17.12.56, **54** (85), 126.—Zinc was the first expendable metal to be used as anode material, and where long life is desired competes with magnesium when galvanic anodes are required for protection from corrosion. G. A. C.

586. Corrosion—and 33 years of pipelining. H. T. Brundage. *Pipe Line Ind.*, 1956, **4** (5), 45–7.—Creole's experiences in Lake Maracaibo show val of good coatings, and cathodic and hot-spot protection. Bottom conditions and marine life affect corrosion. Average pipe life has been increased to 15 years, and may increase to 20. Control is essential. R. T.

587. Pipeline survey and planning. 2. G. I. Russell. *Pipes & Pipelines*, 1956, **1** (2), 28–9.—A well-trained corrosion inspection staff is a major economy. Insulating material should have high elec resistance and very low moisture absorption. No groove should be left at the gasket to trap welding slag and sediments. Test leads are installed at forein structure crossings, insulating flanges, and at frequent intervals on the right-of-way. Internal corrosion, *e.g.* in pipelines handling sour crudes, petroleum products, refinery gases, brine, etc., introduces special difficulties. Use of scrapers, injection of inhibitors, zinc dust, or sol Zn salt is usual, but correct design is most important. Other preventive designs are presented. R. T.

588. Magnesium anodes for pipeline corrosion control. J. S. Gerrard. *Pipes & Pipelines*, 1956, **1** (2), 15–19.—Favourable position in the electromotive series of metals, freedom from polarization, and low cost compared with that of a protected or repaired structure recommend Mg for anodes. When installed an average current of 500–600 amp-hr/lb is obtained. Complete protection of a bare buried steel or spun iron main may require 0·75–5·0 mA current/ft² surface, a well-coated line 0·1–0·2 mA. Anode location relative to the pipe is not important. In designing anode installation for a new, coated pipeline, current density 0·1–15 mA is assumed, additional current, if necessary, is provided by more anodes. Normal criterion for a well-coated line is 0·85 V, in case of suspected sulphate-reducing bacteria 0·95 V. Use of cast Mg anodes—production described—is usually limited to soils of <3,000 Ω/cm resistance. Hot-spot protection may be used for very corrosive areas using Mg anodes. Cast Mg anodes are used—with backfill to increase eff—where soil resistivity is low. Installation details with wt of Mg anodes are given. Cored Mg ribbon ½ × ½ inches, wt *ca* 22 lb/ft² extends application range to include soils > 3000 Ω/cm resistivity, provides faster and cheaper installation methods, and reduces current requirements to minimum. Its resistance is 0·8 Ω/1000 ft, with core resistance 10 Ω/1000 ft, and it can be used with normal type cast Mg ribbon for polarization purposes.

R. T.

589. Tape wrapping of pipelines simplifies construction work. E. Sterrett. *Pipe Line News*, 1956, **28** (11), 68–72.—The application of a polyethylene tape wrapping, together with an outer protective layer of asbestos felt, is described. This wrap has the advantage that no priming or "drying-off" period is required, consequently the wrapping machine may follow immediately behind the cleaning machine and the wrapped pipe can be lowered straight into the ditch. Considerable savings in "cleaning up," inspection, and supervision time may be made, and these offset the higher cost of the tape when compared to conventional primer and enamel.

D. B. S.

590. Corrosion testing equipment. A. R. Murdison. *Pipe Line News*, 1956, **28** (10), 69–75.—This review deals particularly with

the measurement of structure to earth potentials. Measurement of current and resistivity are also discussed. D. B. S.

591. Location of contact between cathodically protected lines and a foreign line. L. F. Heverly. *Pipe Line News*, 1956, **28** (7), 49–54.—The contact point may be precisely located by relating pipe resistance to the distance from the energizing source on either side of the section having the suspected leak. The method has a particular advantage in city areas where excavation costs are high. D. B. S.

ENGINES AND AUTOMOTIVE EQUIPMENT

592. Dampening high-speed pump pulsations. M. Ludwig. *Pipe Line Ind.*, 1956, **4** (6), 38–44.—A mathematical analysis of pulsation effects and their control is presented. The limited compressibility of crude oil and products is used—without a gas-filled chamber—within a surge chamber of practical size, to control pulsations. The liq-filled discharge surge chamber, and a reduced-dia choke tube connected to the pipeline, absorb the pulsating component of flow. R. T.

593. Some experiences in vessels equipped with two-stroke cycle Harland and Wolff opposed piston diesel engines using boiler oil. A. G. Arnold. *Gas Oil Pwr*, 1956, **51**, 285–7.—Fuel consumption can be reduced 6% by turbo-charging; other economies include reduction in engine weight and length and increase in output. Better operating results are also obtained with gas-pressure-operated fuel injection pumps, even considering that heavy fuel is used.

To reduce wear, a series of lubricator feeds is provided at a point between top and second rings when the piston is at t.d.c. These feeds are actuated by high-pressure fuel from the delivery chamber of the injection pumps. It is claimed that this system affords economy of lub oil. H. C. E.

594. Maintenance of road transport engines with particular reference to smoke emission. A. T. Wilford. *Gas Oil Pwr*, 1956, **51**, 276–9, 284.—Some comparisons of combustion efficiency of diesel and petrol engines are given. Emission of smoke is normally avoided by correct injection pump settings (usually lower than the maker's recommendation) and regular cleaning and inspection of injectors (although not necessarily dismantling). Analysis of exhaust gas for CO_2 is used as a control on the fuel pump settings, by means of a completely portable apparatus. A larger type is available for determination of CO_2, free O_2, and CO down to 0·2%.

H. C. E.

595. Rating engines by fuel–air ratio effects. R. J. Cramer and K. F. Froehlich. *Gas Oil Pwr*, 1956, **51**, 296.—If for an engine the input (measured by the amount of fuel injected/stroke) and output are plotted as abscissa and ordinate, the graph near the origin is nearly the same for all 2-cycle engines. The differential thermal efficiency (ΔE) representing the slope of this graph falls to zero when the amount of fuel is so great that all the available O_2 is used. When ΔE falls below 30%, exhaust smoke is visible. Determination of ΔE for some fixed value of fuel–air ratio affords the means of correlating the performances of different engines. H. C. E.

596. Crankcase explosions : an investigation into some factors governing the selection of protective devices. H. G. Freeston, J. D. Roberts, and A. Thomas. *Gas Oil Pwr*, 1956, **51**, 261.—Warning devices should either (1) indicate incipient formation of an explosive medium, or (2) indicate that a source of ignition is being developed. The latter criterion is adopted in the work described.

Oil mists of known composition were enclosed within tubes of cast iron, mild steel, phosphor bronze, brass, Al piston alloy, white metal, and Cu, the temp of which were varied. For mild steel, *inter alia*, explosion occurred in 2 temp regions; from 270° to 350° C, and >400° C, the air–oil ratio being 5–10% wt. A detecting system should therefore give warning at *ca* 265° C.

The efficacy of relief valves was also tested. In a rig (21 cu. ft. cyl) it was found that the max pressures were obtained at air–oil ratio of 12, and that they increased with degree of turbulence and with decrease in vent area. In experiments with a complete crankcase the max pressures were 3 times those experienced with rig work; with a total venting area of 6·1 sq. in/cu. ft. the max pressure developed was 48 p.s.i. It therefore appears that it is impractical to provide sufficient vent area in all parts of the crankcase, and modifications designed to prevent the flame from spreading are necessary.

Under the worst circumstances the max temp of the vented gases was 270° C at a distance of 2½ ft from the relief valve.

H. C. E.

597. Crankcase explosions : development of new protective devices. W. P. Mansfield. *Gas Oil Pwr*, 1956, **51**, 262.—In rig tests it was found that whereas even 10 layers of wire gauze over a 6-inch dia relief valve failed to prevent propagation of flame from the inside to the outside of the vessel, 6 such layers coated with lub oil were completely effective. Such traps could be placed inside the crankcase to prevent the passage of flame between the compartments of a multi-cyl engine (*cf.* Abs. **596**, 1957). In such a test the max explosion pressure was reduced to ½ when internal flame traps were fitted. H. C. E.

598. Gas turbine development. Anon. *Nature, Lond.*, 1956, **178**, 1217.—Report of a conference held at Letchworth, England, in Oct 1956.

The development of an industrial gas turbine of output 750–1000 kW is described. It can be fired by natural gas and coal tar as well as by oil. Problems of servicing are very varied; thus air containing sand appears to have no effect on the turbine blades, but with air containing Na_2SO_4 the blades must be washed every 200–300 hr.

The naval gas turbine may prove most useful in frigates, which need extra power very quickly. Fuel consumption is not important, and the turbine is therefore comparatively simple. For mercantile applications a unit usually runs at full power. In one such set maintenance costs are less than those of steam turbines and much less than for diesel engines.

For use in aircraft the turbo-prop engine has a lower weight and provides greater power compared with a piston engine.

H. C. E.

599. Gas turbine for portable applications. Anon. *Gas Oil Pwr*, 1956, **51**, 243.—This 60-h.p. turbine, introduced mainly for operating pumps, runs at 45,000 rev/min and is geared to the pump shaft, which runs at 3500 rev/min. The unit consists of an annular combustion chamber surrounding a radial compressor and turbine mounted back-to-back on the same shaft. The incoming air is split into 3 streams; one cools the combustion chamber casing, exhaust, etc., another provides the combustion air, and the third cools the face of the turbine rotor.

The fuel system operates at a pressure only slightly greater than that in the combustion chamber, and the unit is governed by restriction of fuel following rise in combustion chamber pressure. The fuel consumption is 10–12 gal gas oil/hr, but any dist fuel can be used. The unit is run up by manual operation, and the burner can be lit either with a match or by Calor gas ignited by a hot wire. H. C. E.

600. Gas turbine-powered liberty ship. Anon. *Gas Oil Pwr*, 1956, **51**, 300–2.—The first ocean-going ship completely

powered by gas turbines averaged *ca* 17 knots on its first voyage, with the turbines developing 6600 s.h.p. max. The unit has 2 groups of 3 combustion chambers, and provision is made for changing the fuel nozzles whilst the set is on load.

The unit will burn residual fuels down to Bunker C grade. Tests indicated that the turbine blade passages would be subject to corrosion and ash deposition from sodium and calcium sulphates, and V_2O_5 would corrode the turbine nozzles. Before use the fuel is treated with an emulsion breaker and water, which dissolves the sodium and calcium salts, and the mixture is centrifuged; $MgSO_4$ is then added to the oil to inhibit the formation of V_2O_5. H. C. E.

SAFETY PRECAUTIONS

601. Fire problem aspects in petroleum industry. T. C. Beresford. *Inst. Fire Engrs Quart.*, 1956, **16** (24), 293–309.—A brief introduction on processes and products in refinery operations, building construction, safety devices, and fixed fire-fighting installations is presented. Most materials in the petroleum industry are combustible and in varying degree inflammable. Information is given on physical and chem properties of materials or classes of materials and their behaviour in fires or fire quenching. Some fl. pt. and b.p. of liq derivates are given. Advice on use of fire-quenching media for sp cases is given, *e.g.* avoiding use of H_2O with Na or K. Conventional quenching media are H_2O, H_2O-fog and spray, CO_2, dry chem powder, chem foam, and special alcohol-resistant mechanical foam. Breathing apparatus and protective clothing are advised for sp cases. Some vapours creep, others attack or are absorbed by the skin, others form explosive mixtures with air. Contact of chlorates with H_2SO_4 produces a violent reaction and toxic vapours. Dry sand, powdered asbestos, and talc are used for Zn, electron, and Al. Chem waste tips containing mixed materials are difficult to treat. R. T.

MISCELLANEOUS

602. The oil industry—its place in the world and its future. J. W. Platt. *J. Inst. Petrol.*, 1956, **42** (392), 217–27.—The paper surveys the present position of the world oil industry and the future trend towards oil and nuclear power. Oil reserves are discussed, and it is pointed out that world dependence on Middle East oil is growing. The author next concerns himself with capital requirements and with the internal organization and human relations of the oil industry. The Soviet sphere is not considered at all in the paper. 3½ pages of discussion are given. C. B.

603. Wanted: integrated oilmen. R. H. Taylor. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 24–6.—Oil industry management wants and needs integrated oilmen. Integrated oilmen are those who supplement their own special skills with awareness of the requirements of the industry as a whole and who act forcefully in the light of that awareness. An integrated oilman must be informed. (Author's abstract.)

604. Responsibilities of international oil companies. T. L. Lenzen. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 35–8.—The development of foreign oil to its present position involved and continues to involve the international oil companies in perplexities of social, economic, and political nature which have very little in common with ordinary operational problems. One underlying factor has enabled the international oil companies to surmount the unique and often discouraging obstacles discussed in this paper. This is the principle that America's interests are best served by free, competitive enterprise. (Author's abstract.)

605. The challenge to the oil industry. A. L. Solliday. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 116.—The oil industry is now facing a big problem which will require unity of purpose and action in obtaining a satisfactory solution. The consumer must be made aware of the nature, risks, and hazards of the oil industry if immunity from government control is to be achieved. In the author's opinion, voluntary control of imports by importing companies will be a means of proving to the public that the industry can solve its own problems without governmental intervention. (Author's abstract.)

606. Atomic energy and the petroleum industry. A. C. Johnson. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 117–21.—Man's consumption of energy is increasing at a rapid rate, making it necessary for him to turn to new sources in the foreseeable future. Atomic fission offers such an alternative source. No revolution is seen, but rather a gradual supplementing of conventional sources with liq fuels continuing in demand, particularly in propulsion fields. Additional applications of radiation are seen in the petroleum industry, one of the pioneers in the use of radioisotopes. In this field, as in the use of reactors to supplement conventional energy sources, a partnership is seen between the atomic energy and petroleum industries. (Author's abstract.)

607. Tax considerations in various oil transactions. J. W. Bullion. *J. Petrol. Tech.*, 1956, **8** (8), 12–18.—There are basically 2 types of production payment—the reserved payment and the carved-out payment. The latter has 2 forms, one of which is sold for cash with no restriction on the use of the cash, while the other is a payment assigned for materials or services, or both, to be used in connexion with the development of the property from which it is carved.

The various types of production payment are discussed, with examples. Reserved and development payments serve a legitimate business purpose, but the carved-out payment, if given capital gains treatment, may permit an improper inroad on the revenue. All 3 types of payment under existing rulings may be used with tax advantages, and aid the industry by providing a means for financing the acquisition and development of properties. G. D. H.

608. Protective labelling of petroleum products. L. C. Beard, Jr., and A. C. Pabst. *Proc. Amer. Petrol. Inst.*, 1955, **35** (III), 427–30.—A fast-moving technology can create new hazards, and progressive medical science can uncover old ones. The practice of protective labelling, long used in the chemical and drug industries, can provide safeguards against unconscious misuse of useful product. Areas of potential hazard may be skin contact, inhalation, ingestion, or use under conditions where fires may occur. Some states have already passed laws making labelling mandatory. The common-law aspects and general provisions of such laws are discussed, and examples are given of suitable labels. Comments are made on how a protective labelling programme may be implemented to the advantage of both manufacturers and users. The responsibility for implementing a labelling programme in an oil company should rest chiefly with a qualified industrial hygienist, assisted by the legal, manufacturing, marketing, and medical departments. (Authors' abstract.)

609. Oil lamp power for radio. Anon. *Elect. Times*, 1957, **131**, 85.—Brief description (photo) of thermopile-operated transistor radio receiver; heat source is incandescent mantle type kerosine lamp, pile built into chimney placed over shortened lamp glass. Average hot–cold junction temp diff 180° C, can yield 100 mW at 1·9 V, sufficient for loudspeaker reception in ordinary room. V. B.

610. Chemicals speed brush control on the right-of-way. J. F. Allen. *Pipe Line Ind.*, 1956, **4** (6), 46–9.—Correct applica-

tion of the right herbicides—the most commonly used are named—cuts weed and brush control costs up to 80% in maintaining right-of-way. R. T.

611. How to clean equipment chemically. R. L. Fiske. *Chem. Engng*, 1956, **63** (12), 187–90.—Chemical cleaning techniques have been developed chiefly in the petroleum refining industry. Chemical cleaners are specialized for particular jobs. Research is being done on combinations of non-ionic and anionic surface-active agents, synthetic detergents plus soap, mixtures of water-soluble solvents, and surface-active agents and acids. Many combinations have a synergistic effect. Methods of cleaning towers are discussed and illustrated by examples. Cleaning by circulation is recommended. The cleaning by detergents of valves, pipes, fittings, and heat exchangers, in a salvage shop, and of tank cars by means of special equipment is described. D. H. A.

612. Current news. Anon. *Nafta (Krakow)*, 1955, **11**, 149–51.—Plan completion in May: crude, 102·1%; gas, 112·3%; gasoline, 100·4%; drilling, 120·1%. Production costs fell below those envisaged in plan by Zl. 52·44/ton of crude, by Zl. 7·4/m³ of natural gas and by Zl. 127·9/ton of gasoline during first quarter of 1955. Concrete impervious to oil was developed at Krakow Polytechnic. Geo-analytical section of Polish IP held 3 lectures on γ-logging, geochemical cartography, and results of geochemical investigation in Poland. M. S.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

000 GAS COUNCIL. Report on natural gas and methane: prepared by the Institution of Gas Engineers at the request of the Gas Council and presented by the Institution to the Council in April 1955. London, Gas Council, 1955. 28 p.

000 SHELL PETROLEUM CO. LTD. The flow of oil: a diagrammatic survey of the petroleum industry. London, Shell, 1955. 27 p.

020 BALCONES RESEARCH CENTER. Thirteenth semi-annual report, December 20, 1955 to June 20, 1956. Austin, Texas, University of Texas, 1956. 51 p. Contains details of the Petroleum Engineering Oil Well Core Depository.

*050 ONIONS, C. T., *ed.* The shorter Oxford dictionary on historical principles. 3rd ed. rev. Oxford, O.U.P., 1944. 2537 p.

*050 WHITAKER, J. An almanack 1957. London, Whitaker, 1956. 1188 p.

080 SHELL OIL COMPANY. Annual report for 1955. New York, Shell, 1956. 26 p.

080 SOCIETY OF CHEMICAL INDUSTRY. Buyers' guide of chemicals, chemical plant, laboratory equipment and apparatus, 1957. London, SCI, 1956. 174 p. Supplement to *Chemistry and Industry*, Dec. 1, 1956.

080 VEREIN DEUTSCHER MASCHINENBAU-ANSTALTEN e.V. Die Bezugsquelle der Mineralölindustrie: Bezugsquellennachweis für den Bedarf der Mineralölindustrie vom Bohrturm über die Verarbeitungseinrichtungen bis zur Zapfsäule. Frankfurt, VDMA, 1956. 137 p.

090 ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION. Oil: the outlook for Europe. Paris, OEEC, 1956. 115 p.

090 ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION. Report of the Special Committee for Nuclear Energy to the Council. Paris, OEEC, 1956. 135 p.

130 BRITISH PETROLEUM CO. LTD. The oilfields of Britain: an account of the search for indigenous petroleum and the discovery and development of the British oilfields by the BP Exploration Co. Ltd. London, BP, 1956. 32 p.

220 AMERICAN SOCIETY FOR TESTING MATERIALS. Methods for reducing the effect of barometric pressure in measurement of octane number, by B. R. Siegel. Philadelphia, Pa., ASTM, 1956. 28 p. (STP 186).

230 ADVISORY GROUP FOR AERONAUTICAL RESEARCH AND DEVELOPMENT. Selected combustion problems, II: transport phenomena; ignition; altitude behaviour and scaling aero-engines. Combustion Colloquium, Liege, Belgium, December 5 to 9, 1955. London, Butterworths, 1956. 503 p.

230 DIN, F. *ed.* Thermodynamic function of gases. 2 vols. London, Butterworths, 1956. Vol. 1. Ammonia, carbon dioxide and carbon monoxide. 183 p. Vol. 2. Air, acetylene, ethylene, propane and argon. 207 p.

230 LEWIS, B., PEASE, R. N., *and* TAYLOR, H. S., *eds.* Combustion processes. London, O.U.P., 1956. 677 p. Vol. 2 of "High speed aerodynamics and jet propulsion."

260 COMMISSIONE TECNICA GOVERNATIVA OLII MINERALI. Norme per il controllo degli olii minerali e deraviti. 4th ed. Milan, Laboratorio Olii Minerali, 1952.

530 ILLINOIS STATE GEOLOGICAL SURVEY. Studies of waterflood performance. II. Trapping oil in a pore doublet, by W. Rose and R. A. Witherspoon. Urban, Ill., State Geological Survey, 1956. 15 p. (Circular 224.)

700 UNITED STATES. BUREAU OF MINES. Bibliography of investment and operating costs for chemical and petroleum plants, supplement 2 (July 1952–June 1954) by E. E. Harton. Washington, D.C., U.S. Dept. Interior, 1956. 127 p. (Information circular 7751.)

730 KELLOGG COMPANY, THE M. W. Design of piping systems. 2nd ed. New York, Wiley, London, Chapman and Hall, 1956. 379 p.

740 ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS. Instrumentation appreciation conference, proceedings, Harrogate, 19th to 22nd April, 1956. London, ABCM, 1956. 189 p.

760 AMERICAN PETROLEUM INSTITUTE. Protection against ignitions arising out of static, lightning, and stray currents. New York, API, 1956. 13 p. (Recommended practice 2003.)

*760 AMERICAN PETROLEUM INSTITUTE. Sparks from hand tools. New York, API, 1956. 3 p.

880 UNITED STATES. BUREAU OF MINES. Safety with solvents, by H. B. Humphreys and G. Morgis. Washington, D.C., U.S. Dept. Interior, 1956. 25 p. (Information circular 7757.)

*910 AMERICAN PETROLEUM INSTITUTE. Petroleum facts and figures. 12th ed. New York, API, 1956. 390 p.

990 WELTY, E. M., *and* TAYLOR, F. J. The black bonanza. New York, London, McGraw-Hill, 1956. 251 p.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

613. Graphic method of dipmeter interpretation using the stereo-net. A. J. de Witte. *J. Petrol. Tech.*, 1956, **8** (8), AIMME Tech. Paper No. 4333, 192–9.—The availability of continuous dipmeter logs makes it desirable that geologists and engineers should be able to make calculations from the original records, and not have to depend on the limited number of calculations made by the service company. The nature of the dipmeter data is described, and the principles underlying the stereographic net are noted. An outline is given of the use of the net in interpreting the survey data, note being taken of the correction for hole deviation and for high angle drift requiring an azimuth correction. The problem of the spinning sonde, which may arise with readings taking in the first 100 ft after pulling of bottom, is discussed.

Instructions for the dipmeter calculations are accompanied by a statement of the step-by-step procedure for calculating dip and dip direction by means of the stereographic net.

G. D. H.

614. Aerial surveys and mapping. P. J. Gibbs. *Proc. Amer. Petrol. Inst.*, 1955, **35** (V), 51–60.—This paper discusses the advantages and economics of aerial mapping over the conventional field survey party and planimetric mapping—advantages of speed in the production of the aerial maps; and economies in cost/mile of mapping, and of greater area coverage.

This new and novel system of mapping warrants the closest scrutiny by any industry which contemplates a mapping programme. (Author's abstract.)

615. Oceanography of Mississippi Delta sedimentary environments. P. C. Scruton. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (12), 2864–952.—The Mississippi, one of the world's great rivers, has transported a vast quantity of sediment to the Gulf of Mexico during its history. Understanding the oceanography around the Mississippi's mouth increases our understanding of the sediments which have formed there and also the oceanography of other similar areas where fresh water meets and flows into the sea.

This is one of a series of papers on shallow-water sediments and their environments of deposition in the N. Gulf of Mexico. Investigation for these reports is being carried out at the Scripps Institution of Oceanography of the University of California under sponsorship of the API. The purpose of this work is to further understanding of older sedimentary rocks through study of their now-forming modern counterparts.

2 areas in the Gulf of Mexico are receiving special study. One is an area of open sea, barrier islands, and bays and lagoons on the central Texas coast near the town of Rockport. The other area is the E. side of the Mississippi River Delta.

The present paper is a more detailed description of a phase of a generalized description of the delta's sediments and environments of deposition and treats parts of the oceanography of the Mississippi Delta's sedimentary environments in such detail as the data now permit. In a continuing project, such a report at this time serves a triple purpose. First, it provides background and new data for interested workers in related fields; secondly, it summarizes existing information and makes it more usable to other workers in the same field; and thirdly, it is a progress report and points out aspects that need additional study.

Particular phases of the delta's oceanography that are considered here are: the currents, waves, and salt content, temp, and suspended sediment. E. N. T.

616. Summary description of Phosphoria, Park City, and Shedhorn formations in Western Phosphate field. V. E. McKelvey *et. al. Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (12), 2826–63.—Information acquired in recent years by the U.S. Geological Survey on the stratigraphy of the Permian Phosphoria and Park City formations and their partial correlatives in the W. Phosphate field shows the need for revision of their stratigraphic nomenclature. Accordingly, a revised plan of nomenclature has been prepared and submitted for approval for publication by the U.S. Geological Survey. Because of the interest the subject holds for petroleum geologists, however, a summary of the plan and brief description of the lithic units involved are presented here. Detailed measured sections of the units and regional correlation charts are included in the longer report. E. N. T.

617. Williston still rates "good hunting." F. J. Gardner. *Oil Gas J.*, 3.12.56, **54** (83), 171.—The Williston basin is said to be one of the best undeveloped basins of N. America in which to search for oil and gas. 2 recent discoveries emphasize this: 1 Tange, a wildcat 1½ miles S. of Outlook, Montana, on test of the Silurian at *ca* 9000 ft flowed 20 brl/hr, and 1 Sorum, Burke County, N. Dakota, reported oil in a Mississippian test at *ca* 5800 ft. C. A. F.

618. Wildcat gets flow. Anon. *Oil Gas J.*, 17.12.56, **54** (85), 97.—1 Fritz, Billings County, N. Dakota, on test at *ca* 8050 ft produced 25 brl/hr of 28° oil. The wildcat, sited on seismic data, is *ca* 80 miles S. of the Nesson anticline, and the tested sands are at *ca* the Otter level.

1 Pearson, Bottineau County, also in N. Dakota, pumped 193 b.d. from Mission Canyon at *ca* 4000 ft on a possible combination structural and stratigraphic trap. C. A. F.

619. Two moves pay off at Catesville. E. E. Kincaid. *Oil Gas J.*, 3.12.56, **54** (83), 96.—The geology, reservoir characteristics, and development under unitization of the Catesville field, Union County, Arkansas, which was found in 1950, are described. Pays are Smackover limestone producing in 4 wells, and the Cotton Valley sands also in 4 wells. Max closure is only 20 ft, and as all pays are thin and at depths down to 7800 ft, close spacing was not economical. 40-acre spacing was adopted, but unitization will permit more economical production from the field and higher recovery.

Total proved stock tank oil in place is approx 17 million brl, and cumulative production to date is 810,000 brl. Cotton Valley sand zones have average permeabilities ranging from 34 to 567 mD and porosities 13·7–22·4%, and the Smackover averages 1060 mD and 18·9% porosity. The Smackover brine contains *ca* 44 lb bromine/1000 gal, and an extraction plant has been built. C. A. F.

620. New Sooner strike. Anon. *Oil Gas J.*, 24.12.56, **54** (86), 53.—1 Kunc, SW. of Taloga, Dewey County, Oklahoma, on test flowed 25 brl of 49° oil in 10 hr from Pennsylvanian Cherokee limestone at *ca* 9200 ft. This is the first discovery in Dewey County. C. A. F.

621. Wolf Springs sparks Central Montana action. N. S. Morrisey. *Oil Gas J.*, 17.12.56, **54** (85), 178.—The Wolf Springs field, Yellowstone County, Montana, was discovered in 1955, and development has now covered an area of 4250 acres. Pay is Amsden dolomite at 6200 ft. The structure is an anticline trending NW.–SE. for 7 miles and up to 1½ miles wide. 18 producers have been drilled, and ultimate recovery is estimated at 2260 brl/acre under water drive. Productivity appears to be related to fracture development in the dolomite. C. A. F.

622. New strike accents enormity of Uinta's oil reserve. F. J. Gardner. *Oil Gas J.*, 10.12.56, **54** (84), 183.—The Uinta basin in NE. Utah has been inadequately tested, although extensive surface indications in the form of bituminous sands and solid and semi-fluid hydrocarbons are known. Commercial oil was first found in 1948 in Tertiary non-marine beds, 11,000 ft of which rest on Mesozoics (10,000 ft) and Palæozoics (4300 ft).

Recently 72–22B Federal in Uinta County tested 45 brl/hr from Tertiary Green River sand at 3560–3580 ft. C. A. F.

623. Reconnaissance of Cenozoic sedimentary rocks of Nevada. F. B. van Houten. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (12), 2801–25.—During oil exploration of Nevada and W. Utah considerable information has been assembled about the fossils and sedimentary rocks of the region. The present author summarizes and reviews previous data (much of which has not been published before) and adds the results of his own field work. E. N. T.

624. Denver–Julesburg basin review and forecast. M. E. Goodin. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 98–111.—The most active single part of the recent Rocky Mountain region oil activity has been the Denver–Julesburg basin in Colorado, Nebraska, and Wyoming. This basin differs from most Rocky Mountain areas in that drilling is predominantly by independent operators. Diversified lease holdings, shallow and comparatively low-cost drilling, and high rate of discovery have been factors in the rapid drilling here.

Although few fields with large reserves have been found, the number of small fields has contributed substantially to the rapid increase of production in this basin. Pipeline outlet has been a major part of the impetus, and currently more outlet is available than is needed.

The oil future of this basin seemed assured with continued extension of generally productive limits. Millions of acres are now leased, with exploratory studies still under way.

One important factor is considered by many as the answer to

the long-range future of oil in the area. Very few wells have been drilled below the productive Cretaceous zones, although production has been established in beds of Permian age on the W. side of the basin, and a major portion of the basin is underlain with beds of Pennsylvanian and Mississippian age, with numerous shows in wells that have penetrated these formations. (Author's abstract.)

625. California's tidelands potentials. C. J. Knight. *Proc. Amer. Petrol. Inst.*, 1955, **35** (I), 17–20.—Proper and orderly development of California's offshore tidelands areas can well double the state's potential oil reserve. Recent state legislation has been designed to prevent wasteful exploitation of reserves such as occurred at Signal Hill, Long Beach, and Huntington Beach in the 1930s. The oil industry must guard against the dangers of nationalization. (Author's abstract.)

626. Fabulous graybeard on another spree. Anon. *Oil Gas J.*, 24.12.56, **54** (86), 40.—A new pay has been discovered in the Santa Fe Springs field, California. The discovery, 1 SP–Pedro–Nepple, a fault block discovery on the W. side of the field, on test flowed 34° oil at 720 b.d. from *ca* 9500 ft. The field was found in 1919, and in 1932 was producing *ca* ⅛ of the total production of the country. It covers only *ca* 2 sq. miles, and by 1955 production had declined to *ca* 12,000 b.d. from 575 wells, with reserves of 50,000,000 brl. Recent discoveries will revive the field. C. A. F.

627. Jumping Pound points up foothills belt possibilities. R. Martin. *Oil Gas J.*, 10.12.56, **54** (84), 184.—The geology and development of the Jumping Pound field, 22 miles W. of Calgary, Alberta, are described. At the surface a zone of many NNW.–SSE.-trending imbricate thrusts involving Cretaceous rocks are bounded on the E. by the Jumping Pound thrust fault, which forms the approx E. boundary of the foothills belt. Beneath this fault there is thrusted and folded porous Mississippian Rundle dolomite pay, which overlies a sole thrust beneath which there are further Mississippian and Devonian beds. Gas is produced from *ca* 11 wells in the Rundle in an area trending some 12 miles from NW. to SE. and ½–2 miles across.

Gas overlies water in porous zones of the dolomite. Total net pay ranges from 95 to 165 ft, and average net pay porosity is 8·2%, with permeability averaging 4 mD from b.h.p. data and connate water averages 10%.

Tables give the stratigraphy of the field and core data, and a structure contour map and cross-section of the field are included. 15 refs. C. A. F.

628. Cuba to be mapped. Anon. *Oil Gas J.*, 3.12.56, **54** (83), 83.—A complete aerial survey of Cuba is to be carried out over the next 2 years at a cost of $1,100,000. A final map at 1/50,000 scale will be prepared. C. A. F.

629. New oil found in Maracaibo. Anon. *Oil Gas J.*, 24.12.56, **54** (86), 54.—A new field has been found off San Timoteo in Lake Maracaibo, Venezuela. The discovery, Ceuta 1, blew out, and pay is reported below 8000 ft. C. A. F.

630. Syria test planned. Anon. *Oil Gas J.*, 24.12.56, **54** (86), 56.—A well is to be drilled in NE. Syria following surface exploration now being carried out.

A wildcat has been drilled at Karatchok which found 150 ft of pay at 6650 ft. C. A. F.

DRILLING

631. Formation evaluation in exploratory drilling. J. E. Walstrom and J. C. Wells. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 122–9.—Formation evaluation as applied to exploratory drilling is a complex and versatile problem. Many factors, both known and unknown, must be considered in working up a programme, and the methods or techniques employed must be both complete and economical. The review includes a brief account of present use and limitations of the various methods employed both during and after penetration, together with a discussion of the relative importance and diagnostic efficiency of these methods in representative petroliferous regions. These include the Tertiary basins of California and the Gulf Coast, and the hard-rock regions of the Rocky Mountains, W. Texas, and the Williston basin. It is concluded that, with the tools now available and proper training in their use, complete evaluation can usually be achieved if these tools are used liberally and in a complementary manner. Future improvements are expected to include more economical tools and a better integration of services by the logging companies. (Authors' abstract.)

632. New mud scores on four counts. J. L. Lummus and B. V. Randall. *Oil Gas J.*, 10.12.56, **54** (84), 118.—A new oil-base mud is described which has improved high-temp stability, contamination resistance, and weight-suspending properties. It consists of a mixture of clay, a partially polymerized organic material, a base, and a cat which, when dispersed in oil, reacts to form a gel.

The mud can be economically mixed with crude or refined oil and can be used as drilling, perforating, packer, or behind-casing fluid. It has had field tests in E. Texas, which are described, and properties have been satisfactory in well temp as high as 350° F. 7 refs. C. A. F.

633. Equipment for air drilling. V. A. LaFave. *Oil Gas J.*, 17.12.56, **54** (85), 113.—Equipment used in air drilling is briefly reviewed. There are 2 basic types of compressor, reciprocating and rotary, and the equipment can be arranged in 4 practical ways: engine-driven compressor units mounted on trailer bed, skid-mounted engine-driven compressors, compound-driven compressors, and compressors driven by V-belt from the rig engine.

The pressure and capacities of compressors required in air drilling are still uncertain, and it is difficult to predict what type of equipment is needed for a particular operation, although curves have been calculated to show the required pressure and capacity for compressors for certain depths using a constant velocity.

Service companies who provide portable equipment with operator are now available. C. A. F.

634. Air drilling falls short. J. O. Scott. *Oil Gas J.*, 10.12.56, **54** (84), 122.—Water seeps in the Bird Creek field, Tulsa County, Oklahoma, have slowed air drilling and coring rates to those comparable using mud. Pressures of only 100–125 p.s.i. have been available, but these have been inadequate to overcome water entry problems. C. A. F.

635. Deep well drilling, Weeks Island, Louisiana, through 1954. N. L. Dodge, J. E. Atkinson, and J. Sedor. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 63–8.—Drilling progress at Weeks Island field, Louisiana, covering the period from 1945 to 1954, is reviewed. Factors contributing to the reduction in average drilling time are discussed individually. Drilling techniques and practices have been developed over this period to the extent that the drilling of a 17,000-ft well in this field is now considered routine. Detailed drilling data are given for 5 wells deeper than 16,000 ft. The most recent of these wells was drilled to a depth of 16,000 ft in 150% less rotating time on bottom than the earliest of these 5 wells.

The most important factors that have aided in reducing average time are: (1) the use of jet bits in conjunction with low-solids-content muds; (2) a decrease in the frequency of time-consuming fishing jobs, resulting from continuous revisions and improvements in drilling techniques; (3) increased

personnel experience and "know-how"; and (4) a general increase in bit weights. (Authors' abstract.)

636. Paradox basin looks good to drillers. N. S. Morrisey. *Oil Gas J.*, 3.12.56, **54** (83), 102.—The Paradox basin in the U.S.A. is rapidly becoming an important oil province with the development of the Aneth trend, now *ca* 20 miles long. Drilling programmes, and time and mud analyses of wells drilled in this area are briefly described. A drilling curve shows the history of a wildcat drilled to 7938 ft in the Elbert formation.

Most Aneth wells are completed in the Paradox between 5800 and 6000 ft. C. A. F.

637. Operating problems—mobile drilling unit. J. M. West. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 69–73.—Before the California Co's S-44 prototype submersible barge of fixed elevated deck design was destroyed by fire, several operating problems were encountered. The complexity of the control system required for the barge moving operation made it necessary that operators proceed cautiously during barge movements.

Because of the water depth in which the barge operated, a driven conductor pipe was required. This was difficult to centre on location, particularly in rough weather. The drill rig floor was approx 55 ft above the bottom of the barge, making differential soil settlement on location troublesome. The S-44 operated without breakwater barges, therefore the barges and service boats which tied up to the rig were exposed to open-water waves without protection. Methods which are being developed to solve these problems are described.

(Author's abstract.)

638. Let's look at offshore mobile units. R. J. Howe and B. G. Collipp. *Oil Gas J.*, 3.12.56, **54** (83), 91.—Since 1949 there has been a steady increase in the number of mobile offshore drilling units operating in the U.S.A. At the end of 1955 there were *ca* 13 of these in use. The different designs of units of this type which have been developed during the past 5 years are summarized briefly with the aid of a diagram. There are 4 main classes: fixed deck units, elevating deck units, elevated deck units, and floating types of units.

Current trends are outlined, together with the potential future development of these units. C. A. F.

639. Something new in a submersible barge. E. McGhee. *Oil Gas J.*, 24.12.56, **54** (86), 56.—A new submersible drilling barge has been designed which has an overall width of 202 ft and length overall of 242 ft. Operating depth of water is 70 ft, and with a low centre of gravity it is completely stable.

Rig base is made of 14½-ft steel tubes, and drilling is off the side from a cantilevered structure. The rig can be skidded in either direction so that 6 wells can be drilled from one position. Jacks on derrick legs allow it to be tilted for use as a construction boom. Mud pumps, rated at 1000 h.p., are driven by two 625-h.p., d.c. motors.

Photographs of the barge and its specification are given. C. A. F.

640. Russia "gang" drills. Anon. *Oil Gas J.*, 10.12.56, **54** (84), 105.—Turbine drilling has been successful in Russia over the past 4 years, and directional drilling using this method has been carried out with 2 to 6 slant holes from one derrick position. This has permitted the economic exploitation of fields previously by-passed because of costly "single-hole" rotary drilling.

Turbodrill slant drilling avoids whipstocks by using special deflectors on the bit. C. A. F.

PRODUCTION

641. Production technology and recoverable oil reserves. T. V. Moore. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 39–43.—This paper discusses the effect of technological developments on the recoverable reserves of petroleum, and offers some opinions as to how processes now in the lab might affect future reserves.

Technological progress has led to a substantial increase in the amount of oil recoverable by modern producing methods. By current production practices many important oilfields will yield well over 50% of the oil originally in place. There are still some areas in which legal, economic, or administrative problems discourage the use of the best production practice, and in these there is an opportunity, through improved production practice, to recover substantial quantities of additional oil. Further developments in reservoir engineering technology will lead to further refinement in conventional production practice and more widespread application of good practice, which will add to the recoverable reserves of oil. There are some types of field, *e.g.* those which produce heavy viscous oil and those where the oil is held in extraordinarily tight reservoir rock, where present-day production practices will not recover economically a large fraction of the oil in place. The petroleum industry is actively engaged in research and development of new methods of recovering oil which should make it physically possible to recover a large fraction of the oil originally in place. These new methods are expensive, and although it is unlikely that they can be applied profitably in all oilfields, they will find important commercial application in many areas. (Author's abstract.)

642. Estimation of primary oil reserves. J. J. Arps. *J. Petrol. Tech.*, 1956, **8** (8), AIMME Tech. Paper No. 4331, 182–91.—There are 3 stages in the life of an oil property, and reserve estimates are made on different bases in each of these. The first employs comparative data (brl/acre), the second volumetric data (brl/acre-ft), and the third performance data (decline curves). In going from the first to the last stage the reliability of the estimates increases progressively. The factors which must be considered at each stage are discussed, and the different approaches are outlined. Reference is made to assessment of primary recovery for depletion-type reservoirs as indicated by taking note of gas–oil ratio, oil gravity, and the type of rock. For water-drive fields multiple correlation analysis of Grange and Buckley's data has indicated the recovery fraction to be $0{\cdot}11403 + 0{\cdot}2719 \log K + 0{\cdot}25569 S_w - 0{\cdot}1355 \log \mu_0 - 1{\cdot}538 f - 0{\cdot}00035 H$, where K is permeability in mD, S_w interstitial water saturation, μ_0 oil visc in cP, f porosity fraction, and H the pay thickness in ft.

Decline and allied curves may be based on constant percentage, hyperbolic, or harmonic declines. Other methods make use of the plots of percentage of oil in fluid produced against cumulative oil, cumulative gas *v.* cumulative oil, or the abandonment contour when there is water advance. Where possible, estimates made by independent methods should be checked against each other. G. D. H.

643. Flowmeter for measuring subsurface flow rates. J. L. Newman, C. Weddell, and H. L. Sauder. *J. Petrol. Tech.*, 1956, **8** (7), 49–52.—The device uses an impeller suspended between 2 torsion wires. A tube attached to the impeller carries a dial which shows the deflection and can be photographed. Below the impeller is a fluid trap to divert flow through the instrument. The apparatus can be run on piano wire. It is 1¾ inches o.d., and nearly 8 ft long, without jars and sinker bar, which increase the length to 15 ft and the weight from 22 to 58 lb. The camera is clock-controlled, and thus a check of timing of operations permits the eventual correct placing of the observations. Changes in direction of flow can be observed, and measurements made on flowing or injection wells so long as there is single-phase flow. Thief zones can be detected. Change of torsion wires allows a wide range of flows to be measured, and successful observations

have been made at rates ranging 60–4000 b.d. under high pressures and temp.

Several flowmeter runs are discussed. G. D. H.

644. Network model of porous media. I. Capillary pressure characteristics. I. Fatt. *J. Petrol. Tech.*, 1956, **8** (7), AIMME Tech. Paper No. 4272, 144–59.—A 2-dimensional tube model has been used to investigate theoretically the capillary desaturation mechanism. Different networks and tube radius distributions were used. If β is the number of tubes connected to each tube, it is apparent that as β increases, the network capillary pressure curves approach the simple bundle of tubes curve. The sensitivity of network capillary pressure curves to changes in network depends on tube radius distribution; for low dispersions all networks have identical capillary pressure curves. The capillary pressure curve is more sensitive to changes in pore radius distribution than to changes in network. A pore size distribution calculated from the capillary pressure curve for a real porous medium by means of the bundle of tubes model will have an average pore radius and dispersion smaller than the true values. The ratio of the calculated and true average pore radius is less than unity, and depends on the network; if β is small the ratio is small, and as β increases so does the ratio, until it reaches unity when β is infinite. The dispersion of the calculated pore size distribution is *ca* $\frac{1}{2}$ of the true dispersion. G. D. H.

645. The S.P. curve: determination of *Rw*, *Rmf*, *Rmf*/*Rw*, and SSP. R. G. Hamilton and P. Charrin. *Oil Gas J.*, 24.12.56, **54** (86), 62.—In quantitative electric log analysis the determination of the resistivity of the connate water (*Rw*) is necessary in order to determine porosity, formation factor, and water saturation. A formula which relates static SP to mud filtrate resistivity (*Rmf*) and *Rw* is given, and with the aid of this and charts and nomograms provided *Rw* may be determined. Examples and necessary corrections are briefly noted. C. A. F.

646. Scale limitations in potentiometric model construction. A. S. Odeh, H. B. Bradley, and J. P. Heller. *J. Petrol. Tech.*, 1956, **8** (8), AIMME Tech. Paper No. 4332, 200–4.—Oilfield displacement problems in which the pressure is relatively constant are frequently studied by means of potentiometric models, in which variations in the product of thickness and permeability are represented by changes in the depth of electrolyte. Apparatus is described which was used for studying the influence of these depth changes in the model, and it is shown that when these changes are appreciable relative to the horizontal dimensions of the model errors arise *vis-à-vis* the oilfield.

Analytical studies were made for a hypothetical oilfield in which permeability varied linearly with distance, and these were compared with the equivalent potentiometric model observations. Deviations of flow times up to 11% were noted. These errors could be reduced by increasing the area of the model relative to the depth.

Dissimilarities in potential distribution may cause errors in predictions from model studies of the history of advance of an injection fluid front, with consequent errors in estimates of the sweep efficiency. G. D. H.

647. Disposal of wastes from California oilfields. H. C. Ferry. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 130–40.—The phenomenal growth in California's population and the rapid expansion of industry, agriculture, commerce, and all branches of the economy requires more and more regulatory legislation, which affects all phases of the petroleum industry's operations, not the least of which is the disposal of oilfield wastes. This important problem will require continued vigilance and cooperation by the industry and governmental agencies as long as oilfields exist in California.

In this article an effort has been made to provide an interesting and informative discussion, which includes a history of oilfield operations, accomplishments of the petroleum industry, a review of applicable federal, state, and local legislation, analyses of legal procedure, co-operation within the petroleum industry and with governmental agencies, and the future outlook. (Author's abstract.)

648. Analysis of fluid input wells by shut-in pressures. A. R. Groeneman and F. F. Wright. *J. Petrol. Tech.*, 1956, **8** (7), 21–4.—Pressure build-up curves used for evaluating producing wells employ equations which can, with certain restrictions, be applied to water or gas injection wells. In this connexion their application may show useful indications about the well and the formation. Different well completion techniques can be compared, and the effectiveness of a workover investigated. Damage or improvement immediately around the well can be studied. The equations require that enough of the injected fluid must be in the formation to ensure that the measured pressure drop occurs in that phase only. In gas wells minor adjustments may be required for the compressibility and weight of the gas column.

In the test the wellhead pressure has to be recorded for a sufficient time for the straight line part of the pressure fall-off curve to be defined (pressure *v.* log shut-in time).

A number of field tests are discussed, and such factors as skin effect and formation permeability are examined. G. D. H.

649. The role of ductility in oil well tubing and casing. F. A. Prange and G. C. Hebard. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 52–7.—Most design of structures and pressure-containing equipment is based on elastic properties of materials. However, mere extension of stress into the plastic range is not sufficient in itself to cause failure. The difference in performance between ductile and brittle materials is acknowledged by variations in allowable stresses. Despite the qualitative idea that ductility is desirable, the statement is often made to the effect that we do not know what degree of ductility is required. This attitude stems in part from inadequate testing, particularly of tubing and casing which has failed. Because the conventional mechanical tests on tubing and casing do not duplicate the mode of failure experienced in the field, the lack of correlation between test results and performance should be expected. The inadequacy of strength as a basis for design of tubing is indicated by failures in high-strength tubing—the sections that burst were the strongest instead of the weakest.

At the same time that yield strength is determined quite precisely, the safety factor to be used in conjunction with the yield strength is determined by no exact method. One difficulty is that little relationship exists between safety (or reliability) and the safety factor. It is difficult to imagine just how large a safety factor would have to be applied to a butane-truck tank made of glass so as to have it just as safe as one built of steel. The ideal in oil well tubing design would be to relate the safety factor to be used with the failure frequency. Burst failures below the nominal yield pressure, however, are caused by a combination of circumstances. For most tubing and casing materials, there must be a notch, a certain degree of brittleness, and plastic deformation. Notches are seams, plug scores, and tong marks; brittleness is the lack of notch ductibility; and plastic deformation may be flattening under tongs, straightening of kinks, and rounding out under hydrostatic pressure.

How much ductility is required of oil well tubing and casing? This question can be answered by checking failed sections by a test method that measures the transverse-notch ductility. Ideally, comparison with random material that performs satiafactorily will indicate fairly closely how much ductility is required to reduce failures to a stated incidence. Such a test

would allow tubing materials to be used more reliably or at a lower safety factor. One possible test method is a notched-flattening test. Characteristics and limitations of this method are compared with other tests. (Author's abstract.)

650. Considerations in the use of high-strength steel for oil well casing. J. P. Fraser. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 141–9.—The use of high-strength steel for oil well casing is attractive economically for very deep wells and for wells having high bottom-hole pressure. The advantages to be realized include adequate design safety factors, lower weight of casing string, and max possible i.d. However, the max usable strength is limited by the behaviour of casing under external hydrostatic pressure, and by the ability of tools to grip the pipe.

The most serious limitation to the use of high-strength casing is the possibility of low circumferential ductility, aggravated by metallurgical defects such as laps, seams, and quench cracks. High-strength steels may prove to be more notch sensitive than the more conventional lower-strength steels now used.

Other considerations include wear and corrosion allowances, as well as the lowered resistance to buckling which accompanies the lower wall thickness of high-strength casing.
(Author's abstract.)

651. In oil-well pumping fit the motor to the job. F. W. Beach. *Oil Gas J.*, 17.12.56, **54** (85), 117.—The effect of using oversize electric motors for pumping units is discussed, and the reasons are given why overpowered motors may be found in some fields. Many field electricity systems are designed according to the anticipated h.p. load, so that if motor-size needs are not accurately determined the transmission systems and transformers will be larger than necessary.

Pumping motors must have high starting torque and sufficient h.p. capacity to pump the well under a fluctuating load without overheating. Their performance can be assessed if voltage, instantaneous amp, kW, and thermal amp can be determined. C. A. F.

OILFIELD DEVELOPMENT

652. Discovery of the Parentis field in the Southwest of France. J. Curutchet, A. F. Farando, M. F. Vigneaux, and R. P. Walters. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 197–213.—In 1951 Esso Standard Soc was granted a permit to explore 4,537,980 acres in SW. France. Details are given on geophysical and geological works and production studies. Parentis deposit was discovered on 25 March 1954, when production at 2254–2264 m was 3 m³ oil in 20 minutes. The well was deepened to 2398 m by diamond coring, the formations traversed being essentially dolomitic. This well was put into definite production under a $\frac{3}{4}$-inch nozzle yielding 560 m³/day. Well No. 1 immediately after being put into production in 1954 gave initial static pressure at 2200 m = 225·7 kg/cm², accumulated production = 0. Wells 1 and 3 showed no sensible pressure drop, measurements = 225·6 kg/cm³ at No. 1 and 225·8 kg/cm³ at No. 3 for accumulated production 55,400 m³. In Jan 1955 Nos. 1 and 3 showed a pressure of 224·4 kg/cm³, a drop of 1·3 kg/cm³ for accumulated production 164,400 m³. A producing section is of Lower Cretaceous age in its upper pt, but Upper Jurassic or a transitory zone between Jurassic and Cretaceous in its lower pt. A discordance separates the pt. This reservoir consists of limestones which are partly and irregularly dolomitized, often porous and fractured. In No. 9 well, 1995 m below sea level, oil–water contact is at 2405 m. Being found at approx the same level in Nos. 3, 4, and 7, it appears to be horizontal. Total ht impregnated is thus 410 m. All results favour the presence of one reservoir only. R. T.

TRANSPORT AND STORAGE

653. The effect of paint colours in reducing storage-tank losses. E. L. Hoffman. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 125–34.—This paper is essentially based on a review of the literature, but the conclusions in the literature reports have been correlated for cone-roof tankage and have been extended to include conservation-type tanks as well.

On volatile-product cone-roof storage, it is concluded that roof and shell should be painted white to reduce inimical temp effects. There is also a discussion on conservation-type tanks, both variable vapour space and floating roof. These tanks are analysed separately, and conclusions reached in regard to roof and shell paint.

The newer pastel colours, including tints of white and aluminium, are discussed briefly, with particular reference to the reasons for their use and their reflective values in relation to white.

In regard to the type of white paint used, there is a brief discussion of the theory involved, including the type of pigment and the type of vehicle, and a discussion on chalking *v.* durability. Finally, a section is devoted to frequency of repainting and present costs, in labour and material, of original painting and repainting. (Author's abstract.)

654. The 33,315-ton tanker *Ryuei Maru*. Anon. *Mot. Ship*, 1956, **37** (439), 353.—A brief description is given of the largest diesel-engined tanker built in Japan. It has 12,000-b.h.p. single-screw machinery. D. K.

655. Loading tankers at sea. Anon. *Mech. World*, 1957, **137** (3451), 82.—The Royal Dutch/Shell Group has installed at its Lutong refinery in Sarawak, British Borneo, a remote control device, operated by tankers moored at the end of submarine cargo loading lines, which is capable of stopping the cargo loading pumps on shore. The method of operation is briefly described. D. K.

656. A.c. auxiliaries for motor ships. M. P. Holdsworth. *Mot. Ship*, 1956, **37** (439), 354.—The author suggests the adoption of a.c. electrical auxiliaries for medium-sized diesel tankers. The requirements in an 18,000-ton vessel are reviewed. The comparative cost between a.c. and d.c. systems is discussed. D. K.

657. Problems of the 100,000-ton tanker. Anon. *Mot. Ship*, 1957, **37** (441), 450.—A consideration of the power output of the machinery to be employed and the most efficient type of power unit is presented. D. K.

658. Derivation of flow equation for liquids. J. M. Campbell. *Oil Gas J.*, 4.2.57, **55** (5), 125.—An equation for the prediction of fluid-flow characteristic is derived from the first law in thermodynamics, enabling an energy balance to be written around any 2 points in a flow system. G. A. C.

659. An approach to evaluating the effect on pipeline capacities of proportional middle distillate movements. J. R. Childs. *Proc. Amer. Petrol. Inst.*, 1955, **35** (V), 33–9.—This paper is an approach to the problem of evaluating the effect of dist vol on pipeline capacity, which is necessary in dividing pipeline time equitably among participating shippers. Several of the factors which apparently contribute to the effect on overall pipeline capacity, as the result of dist movements through the pipeline system, are appraised. The principle of converting dist vol to equated gasoline vol is used in order to simplify the determination of actual capacity in the pipeline system.

Calculations presented are those which apply specifically to the Trans-Northern Pipe Line Co system, with the thought that similar procedures could be applied by other products pipelines. (Author's abstract.)

660. Remotely controlled, unattended pumping stations. T. V. Bockman and R. S. Cannon. *Proc. Amer. Petrol. Inst.*, 1955, **35** (V), 40–6.—The paper attempts to point out various design features and maintenance procedures which operating experience with unattended pumping stations has indicated to be desirable.

An unattended station must be designed for max safety so that it will " fail safe " under any abnormal conditions which might arise. Separation of the pumping building and the control-gear building is desirable. Good equipment is necessary, and a thorough test of all component parts is advisable.

Further research and development on some items of equipment, such as the station throttle valve and emergency shutdown devices, is indicated to produce equipment of the degree of reliability required for unattended stations.

Leased wire circuits, with audio-carrier multiplexing and microwave radio, work equally well for transmission of intelligence for remote control. The economics of the number of circuits required should determine which to use.

Microwave radio equipment apparently is not as complicated as originally thought, in as much as Plantation Pipe Line Co was able to train a young electrical engineer with no previous radio experience to take over maintenance in a few months.

Good co-ordination between mechanical and electrical maintenance groups saves much time and expense on unattended stations. Separate alarm indications on the supervisory equipment for electrical and mechanical faults are desirable at the control point. (Authors' abstract.)

661. Wartime security measures for pipelines. C. B. Lester and H. T. Chilton, Jr. *Proc. Amer. Petrol. Inst.*, 1955, **35** (V), 47–50.—This paper outlines the special measures which would have to be taken, in the event of all-out war, to ensure continuous operation of commercial oil and gas pipeline systems. These include extracrdinary precautions against sabotage, air attack, or land invasion—such precautions designed both to prevent damage and to assist in quick and efficient repair once damage has been inflicted. (Authors' abstract.)

662. Polyethylene tape proves value. M. E. Parker. *Oil Gas J.*, 14.1.57, **55** (2), 133.—Results on a single wrap polyethylene tape on a 12-mile length compared with an adjacent 18-mile length coal tar coated show a superiority in a ratio of 3 : 1 in favour of tape. G. A. C.

663. Data "telelogging." A. P. Jackel. *Oil Gas J.*, 14.1.57, **55** (2), 112.—A new system is described for supplying all of the remote controls at remote-controlled stations with a minimum of communication-line facilities, and for providing means for obtaining this information within a period of seconds, the data being telelogged to the home office. Thus a check on delivery schedules, efficiency of station operation, and product loss is kept.

A diagram of the remote control system is given with a telelogged record sheet for easy analysis. G. A. C.

664. SGA and Southwest research take the pulse of compressor piping. G. Damewood. *Pipe Line Ind.*, 1956, **5** (1), 30–3.—The electro-acoustical analog described is an elec model of a compressor and its associated suction and discharge piping. Elec measurements on the analog are equiv to field measurements at a compressor station. The analog speeds solution of piping design problems in new stations and simplifies modifications to existing ones. 30 problems have been solved successfully. R. T.

665. Getting the most from pump seals. T. J. Sniffen. *Pipe Line Ind.*, 1956, **5** (1), 34–42.—For safe and economical operation in modern pipeline pump stations stuffing box leakages must be stopped. Increased use of automatic control demands max eff. Conventional and improved designs for seals are discussed with supporting drawings. R. T.

666. For Service Pipe Line Co midget booster stations are doing a big job. L. E. Anderson. *Pipe Line Ind.*, 1956, **5** (2), 46–9.—Each of 4 unattended modern booster stations on Service Pipe Line Co's crude pipeline system, Wyoming, has a 1250-h.p. elec motor-driven centrifugal pump to boost pressure on a 3000-b.h. flow. Control devices listed protect units from possible troubles, and relays are provided for shutting down the station. Trained personnel are required to operate the system, especially to understand the telemeter readings received at parent stations by phone. R. T.

667. Long pipeline for solids nearing reality. R. J. Titus. *Pipe Line Ind.*, 1956, **5** (2), 40–3.—Pittsburg Consolidated Coal Co's 10-inch line from E. Ohio mines to Cleveland nears completion. American Gilsonite Co's 6-inch line in Utah and Colorado starts construction. Pilot-scale tests show that abrasion and corrosion problems can be overcome in pipelining solid materials in suspension. For coal transport abrasion is countered by increasing wall thicknesses to 0·375–0·687 inch; int corrosion by inhibitors; ext corrosion by cathodic protection. For Gilsonite transport int corrosion is reduced by deoxidants; ext by cathodic protection; explosion risks are overcome by wet mixing. Reduced transportation costs may place coal in a stronger competitive position with gas and fuel oils. High-purity electrolytic coke and high-octane gasoline will be produced from Gilsonite. R. T.

668. Setting a pattern for future stations. Anon. *Pipe Line Ind.*, 1956, **5** (2), 37–9.—Confidence in remotely controlled, unattended, compressor stations—the ultimate goal for gas transmission main line service—is enhanced by performance of Gulf Interstate Co's satellite station, Stanton, Kentucky. This innovation is efficient, economical, and reliable. Automatic shutdown devices safeguard the station. R. T.

669. 2400-mile line pushes gas frontier to Pacific Northwest. M. A. Judah. *Pipe Line Ind.*, 1956, **5** (2), 24–33.—Construction of the 2400-mile pipeline to convey gas from San Juan basin to the Pacific Northwest is described with illustrations. Every type of terrain—requiring great engineering skill—is featured. Compressor stations are designed for high altitude, cold weather, and 2-way service. R. T.

670. Longest underwater pipeline nears completion. M. A. Judah. *Pipe Line Ind.*, 1956, **5** (1), 10–15.—Problems solved in laying TGT Co's 355-mile Muskrat line, S. Louisiana, are described with supporting illustrations. Various construction methods are applied in completing 285 miles of underwater line. Innovations are modified lay barges to speed up construction, and pulling one Mississippi crossing in catenary across the river bottom. R. T.

671. A look at submarine pipelining. C. F. Horton. *Oil Gas J.*, 21.1.57, **55** (3), 104.—Problems involved in offshore pipelining in the Gulf of Mexico, open lakes and protected bays, and previously-dug canals and trenches are discussed, including that of weight coating, which is common to all types. G. A. C.

672. A viscosity meter for fuel oil. Anon. *Mot. Ship*, 1957, **37** (441), 462.—A Dutch viscosity meter, the Viscotherm, now being marketed in Britain by Frank S. Tolliday and Partners, 65 Bishopsgate, London, E.C.2, consists of a fractional h.p. electric motor driving, through gears, a precision pump. The pump extracts a small but constant flow and forces it through a capillary tube. A continuous reading of visc is obtained by

reading the pressure drop across the capillary. The apparatus is fitted in the fuel supply line between the fuel heaters and the high-pressure pump. D. K.

673. Warehouse design, layout, and material-handling equipment. R. E. Thompson and W. J. Baral. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 135–45.—Union Oil Co of California is completing construction of a $3½ million terminal in the Los Angeles area, the functions of which will include: compounding a complete line of lub oils and greases; packaging and bulk shipment of lubricants and other refined products; distributing packaged goods to marketing stations; and delivering bulk lubricants and packaged goods to metropolitan Los Angeles service stations and consumer accounts. The planning and construction of the terminal are detailed, with emphasis on the main warehouse design, layout, and material-handling equipment. (Authors' abstract.)

674. Bulk oil dispensing vehicle. Anon. *Engineer, Lond.*, 1956, **202**, 669.—Shell-Mex and B.P. Ltd. are to bring into use a fleet of 900-gal tankers, carrying 6 grades of lub oil, to effect a major reduction in distribution costs. 3 200-gal tanks and 3 100-gal tanks are mounted on a Dennis chassis, each tank fitted with individual pump and pre-set metering system controlled from a panel at the rear of the vehicle. Accuracy of metering is within 0·1 gal, an automatic meter cut-off valve coming into operation when the required quantity of oil has been delivered. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

675. Newly designed process heater is turning in good performance. R. Morrow. *Oil Gas J.*, 21.1.57, **55** (3), 88.—A new design for a heater involves double-firing of vertically suspended tube banks, resulting in a more efficient utilization of the costly radiant section tube surface. Firing can be by either oil or gas. G. A. C.

676. Refinery utilities symposium. Steam supplies. D. W. Smith. *Inst. Petrol. Rev.*, 1957, **11** (121), 19–22.—Steam is required for process heating, electricity generation, and mechanical power production. The author explains the steam pressure requirements for each purpose, and then concerns himself with steam raising plant. He describes the various types of boilers which are used and points out that they must be adaptable for burning gas, liq fuel, or even asphalt, special precautions being necessary when residual fuels are used. Finally, the system of allocating and metering steam throughout the refinery is described. C. B.

677. Refinery utilities symposium. Electrical power. W. S. Morris. *Inst. Petrol. Rev.*, 1957, **11** (122), 49.—The refinery applications of electricity, methods of distribution, and process unit installation are reviewed. Lighting and special hazards are also dealt with. G. A. C.

678. Processing under extreme conditions. Various. *Industr. Engng Chem.*, 1956, **48**, 827–921.—15 papers are presented covering various aspects of the subject in both pilot plant and industrial operations. Topics include pumps, compressors, reactors, instrumentation and control, safety precautions, and materials of construction. Papers of particular petroleum interest are abstracted elsewhere. D. B. S.

DISTILLATION

679. Precision distillation column. (In German.) W. Kuhn. *Chem. Ing. Tech.*, 1957, **29**, 6–16.—A description is given of a high efficiency dist column consisting of a number of parallel tubes which may be either empty or packed. A lab column 150 cm long with a separating efficiency of 150 stages at a throughput of 4·6 g/min is described, and details are given of a column 200 cm long with max separating efficiency of 1000 stages. The effect of reflux ratio, throughput, dimensions of exchange path, etc., on efficiency are also discussed. P. J. K.

SOLVENT EXTRACTION AND DEWAXING

680. Recent advances in solvent dewaxing. P. W. Sherwood. *Sci. Lubric.*, 1957, **9** (1), 25.—Modern methods of wax removal, dewaxing solvents, the dual solvent system, versions of the ketone dewaxing process, propane dewaxing, and miscellaneous solvent dewaxing processes are described. G. A. C.

HYDROGENATION

681. Steel-catalysed hydrogenation of carbon monoxide and dioxide. P. A. Lobo, C. M. Sliepcevich, and R. R. White. *Industr. Engng Chem.*, 1956, **48**, 906–12.—The hydrogenation of CO and CO_2 to light hydrocarbons using carbon steel balls as a cat was investigated in a continuous pilot plant suitable for operation at 25,000 p.s.i. at 900° F and 10,000 p.s.i. at 1200° F. The effects of pressure on the products distribution using feed gases of CO–H_2 (over the range 450–15,500 p.s.i.) and CO_2–H_2 (up to 2000 p.s.i.) were studied. The change in hydrocarbon : CO_2 ratio of the product gas when CO_2 was added to the CO–H_2 feed gas was also investigated. The effect of pretreatment and oxidn on the activity of the cat is discussed. D. B. S.

682. Hydrogenolysis of petroleum oils. E. B. Shultz, Jr., and H. R. Linden. *Industr. Engng Chem.*, 1956, **48**, 894–9.—The hydrogasification was carried out under high pressure and temp in a lab reactor. Experiments showed that it was practical to produce a high methane-rich, essentially olefin-free gas of 900–1100 B.t.u/S.C.F. and 0·5–0·6 sp. gr. from low cost residual oils. Using Bunker C fuel oil, 80–85% conversions were obtained at 1200°–1350° F and 2600–3100 p.s.i.g. and a hydrogen : oil feed ratio of approx 200 S.C.F/gal. When this ratio was increased to 300 S.C.F/gal it was possible to convert 90% of the oil at 1350° F and 4000 p.s.i.g. to a gas containing approx 90% methane. The residence times were in the order of 30–60 minutes after the initial gasification temp had been reached. This corresponds to a product gas space–time yield of up to 100 S.C.F/cu. ft. reactor vol/hr, and indicates the commercial potentialities of the process in a continuous reactor after suitable pretreatment of the oil feed. The effects of feed oil properties are also discussed. D. B. S.

683. Hydrogenolysis of bituminous coal. K. C. Channabasappa and H. R. Linden. *Industr. Engng Chem.*, 1956, **48**, 900–5.—Coal hydrogenation at temp of 1200°–1350° F and 1400–3200 p.s.i. was investigated in a lab-scale reactor. The process took place in 2 stages—an initial pyrolysis and hydrogenolysis of the more reactive coal constituents during which the rate of production of hydrocarbons was rapid when excess hydrogen was present, and a second stage in which gaseous hydrogen and the coke-like residue combined to form methane at a slower rate. A higher overall thermal efficiency could therefore be achieved by partial hydro-gasification of the coal and production of hydrogen from the residual char. A bituminous coal heated from 700° to 1350° F at 2500 p.s.i. produced a gas of 870 B.t.u./S.C.F. and 0·5 sp. gr. when a feed ratio of 16 S.C.F. hydrogen/lb coal was used. This corresponds to a product gas space–time yield of 65 S.C.F./cu. ft. reactor vol/hr.

The effects of coal type are also discussed. D. B. S.

ALKYLATION

684. Eastern States alkylates mixed feed. L. Resen. *Oil Gas J.*, 14.1.57, **55** (2), 108.—The operation of the sulphuric acid alkylation unit at the Houston refinery of Eastern States Petroleum Co is described. A M. W. Kellogg cascade reactor as a single vessel with 6 reaction zones is employed. Amylene content has varied from 7 to 18% of the olefin feed, propylene content has remained constant at *ca* 26–29%. G. A. C.

ISOMERIZATION

685. A new isomerization process. Anon. *Petrol. Times*, 18.1.57, **61** (1551), 56.—Details are given of the M. W. Kellogg unit which employs their new process Iso-Kel for isomerizing light naphtha. Thus combined streams of pentane and hexane fractions, as well as natural gasolines, are upgraded. G. A. C.

SPECIAL PROCESSES

686. Vapour phase hydration of 2-butene to 2-butanol. C. B. Dale, C. M. Sliepcevich, and R. R. White. *Industr. Engng Chem.*, 1956, **48**, 913–18.—The hydration was investigated in a continuous reactor between 720° and 730° F and at pressures up to 612 atm using boron phosphate as a cat in both pelleted and silica-gel and alumina-supported forms. The results showed that the pelleted cat was the most active but also the least stable. The silica-gel and alumina-supported cat had properties which were intermediate and the reverse of this observation respectively. The effects of pressure and butene : steam ratio on the products obtained were also studied, the max conversion being 64% of equilibrium conversion. Increasing pressure increased the conversion, but above 510 atm polymerization became a significant factor. D. B. S.

687. Recent developments in petroleum chemicals. P. N. Collingswood, C. F. M. Mackintosh, and H. Steiner. *Petrol. Times*, 15.2.57, **61** (1553), 146.—A review is given of the petroleum chemical industry for the U.S.A., Europe, and Japan, trends and recent developments being outlined. Tables show U.S. production of crudes from petroleum and natural gas for chemical conversion, estimated production of petroleum chemicals in the U.S.A., and projected Japanese plants. G. A. C.

688. The "Shell" hydrodesulphurization process. G. R. Storey. *Inst. Petrol. Rev.*, 1957, **11** (122), 35.—Hydrodesulphurization is defined, reactions in the process described, and the development of the "Shell" process is reviewed. The Stanlow refining unit designed for the production of a desulphurized diesel oil component from light cat cracked cycle oil and straight-run gas oils came on stream early in 1955; a flow diagram and feedstock property tables are given. G. A. C.

METERING AND CONTROL

689. Refining moving ahead. Anon. *Oil Gas J.*, 28.1.57, **55** (2), 180.—A review is given of use of centrifugal compressors, controls, metering, computers, communications, and metering in pipelining of products. G. A. C.

690. Rate of approach to steady state by a distillation column. R. F. Jackson and R. L. Pigford. *Industr. Engng Chem.*, 1956, **48**, 1020–6.—Computers were used to calculate the time required for dist columns to attain a steady state when transient changes in composition occurred. 2 types of operation were studied: enriching columns fed with a constant composition vapour from an infinitely large boiler and columns having very small reboiler hold-up and filled initially with equimolar amounts of the 2 components. Binary mixtures having a constant relative volatility were dist at total reflux and the effects of variations in the composition of the constant vapour supply, the relative volatility, the number of trays, and the tray efficiency were studied independently. The results showed that the time needed for a column to reach its steady state was approx proportional to the square of the number of trays that it contained. D. B. S.

691. Automatic control in continuous distillation. T. J. Williams, R. T. Harnett, and A. Rose. *Industr. Engng Chem.*, 1956, **48**, 1008–19.—The problem of maintaining correct control in a dist column when the feed rate is varying may be treated in a similar manner to one of varying feed composition, provided that an additional separate controller is used to maintain the boil-up rate as a definite multiple of the feed input rate. The effects of imperfect sampling on the control response of the column, the feed quality, the sampler location, and input *v.* output control are fully discussed. D. B. S.

692. Transient chemical process behaviour and control. Various. *Industr. Engng Chem.*, 1956, **48**, 999–1079.—12 papers on various aspects of automatic control, dealing in the main with the dynamic relationship of the instrument to the process with which it is associated and the use of computers for analysing the system variations. 3 papers of particular petroleum interest are abstracted separately. D. B. S.

693. Sampling and control characteristics of an analysis-controlled pentane fractionator. D. E. Berger and G. R. Short. *Industr. Engng Chem.*, 1956, **48**, 1027–30.—The use of a process refractometer for the automatic control of a fractionator separating *iso*pentane from *n*-pentane is described and the choice of a suitable sampling point discussed. Step changes were made in the composition control point and the reboiler heat input in order to study the column's control action. It was found that a step change of *ca* 2% *iso*pentane in the control point produced an immediate change in the reflux and product flow rates but that the sample tray composition did not settle for *ca* 30 minutes. A change in reboiler heat input at constant control point required approx twice the length of time to settle, probably due to the longer and more involved signal path. It was concluded that the speed of response to control action was limited by the system's ability to mix and to transfer a considerable vol of material through those stages of the column which were included in the control loop. D. B. S.

694. Simple jet pump design. R. H. B. Forster. *Brit. Chem. Engng*, 1956, **1** (1), 12–15.—A simple form of the pump—functioning as an injector or ejector—is illustrated and explained. Uses are: fume extraction; vac production; vac augmenting; vapour compression; thermo-compression; draught augmenting; gas boosting; sump drainage; chem metering; and solid conveying. These are discussed singly. An approx design method is given. R. T.

695. AGA research promises more accurate flow efficiency tests ahead. R. F. Bukacek and R. T. Ellington. *Pipe Line Ind.*, 1956, **5** (1), 16–21.—Economical operation of the vastly increased gas pipeline systems demands high flow eff. AGA indicates the need for standardizing testing procedures and ensuring accurate field measurements. Use of anhydrous ammonia as tracer to measure gas flow is discussed. Recommendations are included. R. T.

PRODUCTS

CHEMISTRY AND PHYSICS

696. Synthesis and properties of C_{16}–C_{24} branched aliphatic hydrocarbons. A. D. Petrov. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1471–83.—Various possible syntheses of branched hydrocarbons containing several adjoining tertiary C atoms, or linkages with 2 quaternary carbons, are discussed. A new method is based on the condensation of the pinacol fluorohydrins with organo-magnesium cpds. Particular attention is given (from point of view of use as diesel fuel) to relationship of structure and freezing point, values of the latter as low as −90° C (C_{16}) being obtained. V. B.

697. Catalytic dehydrogenation of methyl-2-butane. N. J. Chouikine, T. P. Dobryna, and E. A. Timofeieva. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1485–8.—*iso*Pentane (methyl-2-butane) passed (0·5 vol/vol/hr) at 527° C over Al–Cr cat (K promoted) yields 87% of liq product containing 42–64% of mixture of the 3 possible *iso*pentenes (methyl-2-butene-2 preponderating); average *iso*pentene yield is 37·8% on starting material. Cat can be regenerated by ignition in air at 550° C. V. B.

698. Applied chemical kinetics. XV. Explosive reactions. J. C. Jungers and P. Leprince. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1406–69.—(*Cf.* Abs. **251**, 1957.) V. B.

ANALYSIS AND TESTING

699. Development of a method for simple and accurate determination of hydrocarbon type on the basis of viscosity, refractive index, and density. J. Cornelissen and H. I. Waterman. *Chim. et Industr.*, 1956, **76**, 1019–31.—A tridimensional model constructed on co-ordinates of log ν_{20}, n_D^{20}, and d_4^{20} is used for preparation of diagrams, which are transverse sections of such a model, having co-ordinates of n_D^{20} and d_4^{20} and from which $\%C_A$ and $\%C_N$ can be read. As even an appreciable change in visc has only a slight effect on $\%C_A$ and $\%C_N$, 6 separate diagrams are given for values of log ν_{20} (cS) of 0·3, 0·5, 1·0, 1·5, 2·0, 2·5; values for intermediate visc can be obtained by linear interpolation. A correction of −3% to C_N is required for every % of S in the sample. Results are given on *ca* 100 fractions for which analyses are available by the earlier *v–n–d* and *n–d–M* methods. V. B.

700. Development of test method for assessing influence of lubricant on piston seizure in 2-stroke petrol engines. A. Dyson. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1489–95.—Seizure occurs when load-bearing surfaces attain certain temp, depending on lubricant and clearances. Spread between seizure temp for good and bad oils can be *ca* 50° C, corresponding to a pressure difference of 15 kg/cm². Tests by the method of repeated seizures showed bad repeatability, owing to undue distortion of parts; if, however, the test is stopped when seizure is imminent, as indicated by a fall of engine speed, then such " tightening temperature " (5°–10° C below seizure temp) is repeatable. Test commenced at brake rotation (ratio 4·75) of 970 rev/minute, after 10–15 minutes cooling air is cut off and the test stopped at a brake speed of 920, cyl temp being noted by thermocouple, 1 mm within cyl wall at t.d.c. level. V. B.

701. Recommended methods for the analysis of trade effluents. Methods for the determination of non-volatile matter extractable by light petroleum and the determination of volatile immiscible liquids. Anon. *Analyst*, 1957, **82**, 123–6.—Prepared by joint ABCM–SAC committee. In the first method an effluent sample (*cf.* Abs. **118**, 1957, for sampling technique) is flocculated with $MgSO_4$ and lime, settled, and most of the aq layer siphoned off. Ppt is dissolved in dil HCl and extracted twice with petroleum ether boiling <40° C. Extract is dehydrated with Na_2SO_4, filtered into a tared flask, and evaporated to dryness on a water bath. For the second method *cf.* Abs. **119**, 1957. W. A. M.

702. Radioisotopes in refining. 4. Shell puts radioisotopes to work. Anon. *Oil Gas J.*, 7.1.57, **55** (1), 111.—Case histories are outlined, including leak detection and fluid cat and entrainment studies; desirable characteristics of isotopes are stated. G. A. C.

703. Electronic engine indicators in fuel research. R. K. Vinycombe. *Petrol. Times*, 15.2.57, **61** (1553), 151.—Accurate versatile electronic equipment permits studies of rapidly varying pressures, vibrations, and temp, and thus determines conditions in every part of the engine. The use of such electronic devices is reviewed. G. A. C.

704. Analytical methods for higher petroleum fractions. A. Crozier. *Rev. Inst. franç. Pétrole*, 1956, **11**, 869–912; 1129–60; 1232–68.—Constitution of the 200°–300° C petroleum fraction is discussed and methods for the analysis and investigation of such fractions described (structural analysis; fractionation by dist, adsorption, crystallization, thermal diffusion; identification and estimation by phys and chem methods). Results are given of the application of structural analysis methods to both pure hydrocarbons and cuts from Lacq, Staffelfelden, and Sidi-Fili crudes. Various methods of calculating structure are compared; on the whole, agreement is fair. A description is given of experimental equipment used in analysis of the 200°–300° C fraction, from 5 French and Moroccan crudes, each fraction separated into 10° C cuts, each of which was subjected to detailed examination (measurement of *n*, *d*, mol. wt., an. pt., dispersion, aromatic content (by FIA analysis and sulphonation), analysis of saturates resulting from sulphonation), from results of which structural analysis was carried out by the *n–d–M* method. Order of increasing aromaticity ($\%C_A$ 2·4–25·7) was Staffelfelden, Sidi-Fili, Lacq (upper), Parentis, Lacq (102); results are given in considerable detail, especially for the first and last of the crudes, for which urea crystallization and u.v. spectra were also employed. Adamantane was isolated from the Lacq (102) fraction. 254 refs. V. B.

705. Potentialities of viscosity control. W. Barker. *Brit. Chem. Engng*, 1956, **1** (1), 16–19.—Types of viscometer and uses are discussed. The ultrasonic viscometer measures the interaction of ultrasonic elastic waves with the fluid under observation. The system comprises a probe, an electronic computer, and a coaxial connecting cable. It may be used for oil blending. Visc control with the Viscoson is increasing. Hermetically-sealed sensing elements, instantaneous response, and automatic temp compensation make it useful to chem and petroleum industries. It is useful for solvent refining and fuel atomatization. R. T.

706. Ultra-violet determination of phenolic antioxidants in rubber. C. W. Wadeline. *Analyt. Chem.*, 1956, **28**, 1530–1.—The determination of phenolic antioxidants in synthetic rubber by u.v. absorption is subject to interferences from other materials present in the sample which may be extracted with the solvent. However, in extracts of GR-S the only substances which undergo a change in u.v. spectrum as a function of basicity are phenolic antioxidants. By choosing a wavelength where the antioxidant has a low absorptivity in neutral soln and a higher absorptivity in 0·1N alcoholic potassium hydroxide soln and measuring the increase in absorbance, the amount of antioxidant can be accurately determined. The method has been successfully applied to Ionol 2 : 6-di-*tert*-butyl-4-methyl phenol and Antioxidant 2246 methylene-*bis*-2,2′-(6-*tert*-butyl-4-methylphenol). J. S.

707. Trace unsaturation of hydrocarbons by coulometric titration. F. A. Leisey and J. F. Grutoch. *Analyt. Chem.*, 1956, **28**, 1553–5.—Trace unsaturation of hydrocarbons in the petroleum industry is frequently measured by the addition of bromine. In a new technique for measuring unsaturation, olefins are titrated coulometrically with bromine, and the end point is detected amperometrically.

The time of titration is proportional to the bromine added to the sample. Better than 0·5% agreement has been obtained, with theoretical values for synthetic samples over a bromine index range of 0–180. The method is rapid, accurate, and well suited to routine use. J. S.

708. Variables in lamp design that affect smoke point. F. W. Rakowsky and R. A. Hunt, Jr. *Analyt. Chem.*, 1956, **28**, 1583–6.—A study has been made of the physical variables of a wick-type lamp that affects the smoke point test of petroleum dist. Wick dia, chimney dia, chimney height, and relative height of air screen and wick guide affect smoke point. Lamp dimensions that gave max distinction between fuels were used in designing a new lamp with an improved mechanism that increased precision. The new lamp correlates well with the Factor Lamp and the widely used IP Lamp. It offers a more precise way of determining the burning quality of jet fuels and heating oils. J. S.

709. Gas chromatographic determination of some hydrocarbons in cigarette smoke. H. W. Patton and G. P. Touey. *Analyt. Chem.*, 1956, **28**, 1685–8.—A gas chromatographic method for the determination of ethane, ethylene, acetylene, propane, propylene, *iso*butane, and butane in the gaseous phase of cigarette smoke was found to be effective for the separation of these cpds from others present in this complex mixture.

By using a column containing silica gel and employing helium as a carrier it was possible to determine 7 hydrocarbons in a 10-ml sample of smoke, and the use of other column packings and conditions should enable the analysis of some other components of cigarette smoke. The gas chromatographic method should also be useful for separating components present in the gaseous phase of cigarette smoke for identification by other means, particularly mass spectrometry. J. S.

710. Rapid method for simultaneous determination of sulphur and phosphorus in petroleum products. P. B. Gerhardt and G. V. Dyroff. *Analyt. Chem.*, 1956, **28**, 1725–8.—An extension of the high-temp combustion technique permits the rapid determination of sulphur and phosphorus in the same sample in an elapsed time of *ca* 20 minutes. The sample, mixed with zinc oxide, is burned in a high-temp combustion unit. The sulphur dioxide evolved is absorbed in an acid–iodide soln and the sulphur determined by immediate titration with potassium iodate. The residue of zinc phosphates in the combustion boat is dissolved in acid and the phosphorus determined colorimetrically as molybdivando phosphoric acid. The estimated standard deviation of the phosphorus test is *ca* 0·02 above the 0·1% level and 0·003 below the 0·1% level, and for sulphur it is 0·025 above the 0·1% level and 0·01 below the 0·1% level. J. S.

711. Factors affecting use of dielectric methods in determination of sea water in Navy Special fuel oil. T. D. Callinan, R. M. Roe, and J. B. Romans. *Analyt. Chem.*, 1956, **28**, 1911–16.—The dielectric constant, % power factor, dielectric loss factor, and conductivity of a number of boiler fuels were evaluated as a means of measuring the sea water content of Navy Special fuel oils. These properties varied considerably from one fuel oil to another at comparable frequencies from 10 kc/s to 75 Mc/s. When these oils were emulsified with synthetic sea water the values so obtained increased with sea water content but remained a function of the characteristics of the original fuel oil. When an accuracy of ±20% is required the data obtained indicate that the dielectric constant method is inapplicable. J. S.

712. Hydrocarbons in the 126° to 130° C fraction of petroleum. M. B. Epstein, C. B. Willingham, B. J. Mair, and F. D. Rossini. *Analyt. Chem.*, 1956, **28**, 1924–7.—7 hydrocarbons were found in the fraction of petroleum boiling between 126° and 132° C, which constitutes approx 0·68% by vol of the original crude. These cpds were concentrated by extended use of the fractionating processes of dist (regular, azeotropic, and at reduced pressure) and absorption. The cpds were identified by i.r. and mass spectrometric examination, coupled with measurements of the simple physical properties.

The names and estimated relative amounts of the 7 cpds in this fraction of petroleum are: 53% ethyl*cyclo*hexane; 16% 1-*trans*-2-*cis*-3-*trans*-4-tetramethyl*cyclo*pentane; 9% 1-*cis*-2-dimethyl*cyclo*hexane; 6% 1-methyl-*cis*-2-ethyl*cyclo*pentane; 5% 2,3,5-trimethylhexane, and 2% *iso*propyl*cyclo*pentane. J. S.

713. Relationship between carbon-type composition, viscosity–gravity constant, and refractivity intercept of viscous fractions of petroleum. S. S. Kurtz, Jr. *et al.* *Analyt. Chem.*, 1956, **28**, 1928–36.—A triangular graph has been developed which relates carbon-type composition in terms of % aromatic carbons, % naphthenic carbons, and % paraffinic carbons to visc-gravity constant and refractivity intercept for visc petroleum fractions. If the visc-gravity constant and refractivity intercept are known, carbon-type composition can be determined from this graph with reasonable accuracy. Visc, gravity, and refractive index are the only experimental data required for the use of this graph. It is useful in following the effect of solvent extraction, acid-treating hydrogenation of the visc fractions of petroleum, and for comparing the composition of the visc fractions from various crude oils. J. S.

714. Determination of saturated hydrocarbons in heavy petroleum fractions by mass spectrometry. H. E. Lumpkin. *Analyt. Chem.*, 1956, **28**, 1946–8.—A procedure for the type analysis by mass spectrometry of the saturate portion of petroleum fractions of high mol. wt. has been developed. The method is simple and rapid and lends itself to inverted matrix and computer calculation. The calculation, including numbering the masses on the record, reading the peak height of 55 masses, summing the groups, and solving the equations with an inverted matrix requires *ca* 40 minutes. Any group with an instrument capable of resolving and pumping out petroleum materials in the high boiling range from heating oils to lub oils should be able to apply the method directly in analysing saturate fractions. J. S.

715. Fluorescent indicator adsorption method for hydrocarbon type analysis. Application to traces and to heavier distillates. H. S. Knight and S. Groennings. *Analyt. Chem.*, 1956, **28**, 1949–54.—The saturated, olefinic, and aromatic component types in lighter petroleum dist are commonly determined by the Fluorescent Indicator Adsorption (FIA) method, in which a small sample is passed through a long narrow chromatographic column and the composition is computed from the lengths of the zones. This method has been extended to the determination of hydrocarbon types in smaller than normal concn and to the analysis of cracked gas oils and lub oils. For the determination of small quantities, 0·1 to *ca* 3%, of one type in the others, the permanent zone developed by the usual procedure is too short to measure. This was overcome by using a larger sample and calculating the concn of the trace component by means of a calibration factor. Analysis of heavier dist was accomplished by alteration of column dimensions, addition of a special dye, and dilution of the heaviest oils to reduce their visc. J. S.

716. Cone-plate viscometer. Comparison with coaxial cylinder viscometer. R. McKennell. *Analyt. Chem.*, 1956, **28**, 1710–14.—The cone-plate viscometer provides a rapid means of obtaining reproducible flow measurements on non-Newtonian fluids by subjecting the sample to definite uniform shear rates. The conventional coaxial cyl viscometer suffers the disadvantages of shear rate variations across the measuring annulus, end effects, limited range of operation, and filling, cleaning, and centering operations. The cone-plate configuration provides constant shear conditions without introducing constructional complexity. In practice, filling, cleaning, and temp stabilization can be completed in *ca* 30 sec. The flow curve recorder is capable of plotting a curve in 15 sec with uniform shear acceleration. J. S.

717. The examination of waxes. C. L. Jones. *Paint Technol.*, 1956, **20** (229), 361; 1957, **21** (232), 9.—Before any analysis tests can be made, the taking of a fair sample must be ensured, and the rules of the American Wax Importers and Refiners Assoc Inc are discussed. The methods for the determination of the melting, setting, softening, and dropping points of waxes are reviewed. Methods of determining refractive index are discussed, together with its use in detecting adulterants in waxes. Other physical methods for the examination of waxes and for assessing some of their mechanical properties are considered; they include cryoscopic determination of mol. wt., fl. pt. determination, hardness measurement by durometer and penetrometer, tensile strength and ductibility assessment, X-ray diffraction analysis, i.r. spectroscopy, and chromatography. D. K.

CRUDE OIL

718. Porphyrin–metal complexes in petroleum stocks. H. N. Dunning and N. A. Rabon. *Industr. Engng Chem.*, 1956, **48**, 951–5.—Small amounts of porphyrin–metal complexes often remain in partly refined petroleum products where they adversely affect processing and utilization. Vanadium– and nickel–porphyrin complexes were isolated from a propane-deasphalted raffinate by chromatographic and solvent extraction methods, and identified by spectrophotometric analysis of the extracts. Correlations indicated the porphyrins involved to be carboxylated types, and their presence as a stable complex combined with trace metals prevented the removal of the metals by conventional methods. D. B. S.

GAS

719. L.P. gas up by 1 billion gallons. Anon. *Chem. Engng News*, 7.1.57, 124.—Last year's total sales of LPG were 6997 million gal, a 16·7% increase over that of 1955. Much of the increase has arisen from growing demands for polyethylene and other polymer plastics. Synthetic rubber has accounted for 439 million gal, an increase of 8·1% over 1955. Further products from LPG include phenols, acetones, glycols, amines, detergents, and various other oxygenated hydrocarbons. Domestic heating and motor fuel comprise the largest market for LPG, and last year accounted for 4068 million gal.

Underground storage capacity will shortly be increased from *ca* one billion to 1½ billion gal. W. H.

720. Liquefied petroleum gas in bulk for industries in S. Africa. Anon. *Engineer, Lond.*, 1956, **202**, 748.—First rail car of 6400 gal LPG was delivered from Standard Vacuum Co's Durban refinery to a S. African glassworks in Sept 1956. Composition was 30% propane, 35% *n*-butane, 35% *iso*butane, with 1 part in 10,000 added odorant (ethyl mercaptan). 8 rail cars will be in commission by early 1957, the cars being constructed of 1½-inch plate and weighing 12 tons each when empty. A number of S. African industries are switching to this clean fuel, including metal container manufacturers, motor assembly plants, and cereal manufacturers. Smaller supplies in cyl are also available. Photographs of rail car and storage tanks. A. C.

721. Use of natural gas in Scotland. Anon. *Engineer, Lond.*, 1956, **202**, 835.—Scottish Gas Board is to carry out a prolonged test of natural gas resources at Cousland, nr Edinburgh. Purpose is to observe the pressure decline of a well drilled before the late war, to assess the limits of prospective formation (existing wellhead pressure 600 p.s.i.g.). Gas will be piped 4 miles to Musselburgh and mixed with coal gas for domestic and industrial use. If the test leads to commercial production, a coal saving of 5000–10,000 tons/year is anticipated. A. C.

ENGINE FUELS

722. "Two for the money"—gasoline and motor oil are partners. H. C. Vesper. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 67–74.—An effective fuel–lubricant combination has been developed in the past 10 years to meet the requirements resulting from engine design advances and changed operating conditions. Specific improvements have included increased octane and reduced sulphur levels of gasolines, use of more effective additives in both gasoline and oil, and the development of multigrade oils. Newly-developed lub oil additives can be expected almost to eliminate engine sludge formation in the near future.

Marketing techniques have not kept pace with technical developments, possibly because the interrelationship of gasoline and lub oil has not been stressed. The petroleum industry and individual marketers must be made aware—and must convince automobile manufacturers' service representatives, new-car dealers, mechanics, and service-station salesmen—of this interrelationship and of the need for realistic oil drain periods if the advantages of the combination are to be fully realized. (Author's abstract.)

GAS OIL AND FUEL OIL

723. Opportunities in the distillate market. B. L. Ray. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 105–8.—Fuel oil suppliers and marketers must constantly develop new opportunities to improve the relative position of dist fuels in the energy market. A comprehensive programme to achieve this goal should include: aggressive advertising campaigns stressing the advantages of automatic oil heat; co-operative action of local supplier–marketer groups assisted by oil heating market reports; improvement of oil heat service by more thorough training of service mechanics and more efficient service operations, including dispatching; research to develop better oils, improved methods of burning oil, and simpler and more compact factory-assembled equipment; promotion of a summer demand for oil for water-heating and air-cooling equipment; development of a code of minimum installation standards for oil-burning equipment; and expanded sales efforts, including development of new aggressive techniques and a well-trained, enthusiastic sales force. (Author's abstract.)

LUBRICANTS

724. The friction and lubrication of solid surfaces. F. P. Bowden and J. W. Menter. *J. Inst. Petrol.*, 1956, **42** (395), 301–3.—A brief account of a paper read to the Symposium on Lubrication held under the auspices of the Chemical Society, the IP, Royal Institute of Chemistry, and the Society of Chemical Industry on 19 April 1956 at the University, Manchester. The occurrence and significance of adhesion between surfaces is considered, and the general pattern of friction and metallic transfer of metals is found to apply to non-metals. Polytetrafluorethylene is mentioned as a low-friction material. High temp properties of MoS_2 and graphite are discussed. Mention is made of high-temp experiments involving

dry metals sliding *in vacuo* at high speeds. Boundary lubricants and rolling friction are briefly considered. 1½ pages of discussion. C. B.

725. Hydrodynamic lubrication and its application to bearing design. F. T. Barwell. *J. Inst. Petrol.*, 1956, **42** (395), 304–15.—After considering the applicability of the usual design parameters, the author develops an expression for the duty which a bearing has to fulfil. This is the "mechanical viscosity," analogous to the mechanical O.N., and is the viscosity of the lubricant multiplied by a factor which depends on the dimensions and conditions of operation of the bearing. Visc requirements of the bearing are considered with reference to air as a lubricant. A description is given of the work of the Mechanical Engineering Research Laboratory on high-speed bearing operation, with the emphasis on friction, temp distribution, and lubricant flow. A detailed account is given of a visual investigation into lubricant film conditions using transparent bearings. Throughout the paper the author is concerned with the parts played by the petroleum technologist and mechanical engineer in the design of bearings, and he concludes that petroleum products will be of first importance in the field of lubrication for many years to come. 15 refs and 2 pages of discussion. C. B.

726. The frictional properties of molybdenum disulphide. J. W. Midgley. *J. Inst. Petrol.*, 1956, **42** (395), 316–22.—The author is concerned with the dependence of the lubricating properties of MoS_2 upon temp and humidity conditions. He suggests that the frictional resistance of unbonded and resin-bonded natural MoS_2 films decreases with increased dryness of the film, and shows that this theory correlates directly with the published experimental results of other workers in the same field. A brief comparison is drawn between the frictional properties of MoS_2 and those of graphite, and their practical significance is discussed. 11 refs and 3 pages of discussion. C. B.

727. Solid lubricants. E. A. Smith. *J. Inst. Petrol.*, 1956, **42** (395), 322–9.—After a short introduction concerned with the properties of a good solid lubricant, the author describes the structural aspects of graphite as a lubricant. He considers the absorption on metals of graphite, its frictional properties, and industrial aspects of its use. Molybdenum disulphide, glass, talc, mica, camphor, and various other solid lubricants are briefly described. 6 refs and 2 pages of discussion. C. B.

728. Some lubrication problems of aviation gas turbines. V. W. David, J. R. Hughes, and D. Reece. *J. Inst. Petrol.*, 1956, **42** (395), 330–6.—The paper describes the lubrication requirements of gas turbines, and pays particular attention to load-carrying capacity, the effect of speed on this, and low-temp performance. Tests run on a modified IAE 3½-inch centres gear rig show that load-carrying capacities of both synthetic lubricants and mineral oils containing E.P. additives decreased with increasing speed. Conclusions drawn from visc–temp measurements suggest that synthetic lubricants should give better low-temp performance than mineral oils, but results from cold room tests indicate that this is not true. The relation between starting torque and visc of the lubricant is also ascertained from cold room tests. This was found to be related to the square root of the visc obtained from linear extrapolation of the standard ASTM chart. Low-temp pumpability was also found to be related to the linearly extrapolated visc. It is concluded that although for low-temp performance synthetic lubricants will have to be used, mineral oils would be satisfactory for suitably designed engines in less extreme conditions. 4 refs and 1½ pages of discussion. C. B.

729. Friction and wear studies of chlorinated methylphenyl silicones. R. C. Bowers *et al.* *Industr. Engng Chem.*, 1956, **48**, 943–50.—Silicones are attracting increasing interest as lubricants, but their application is limited due to their inability to lubricate steel–steel interfaces. Friction and wear studies were carried out using an unchlorinated and 3 chlorinated methylphenyl silicones in a Bowden Leben apparatus and a 4-ball wear machine. Combinations of hard steel, soft steel, and copper were investigated at temp between 77° and 600° F, and it was found that the lubrication improved with the extent of the chlorination, probably due to the formation of a protective chloride film. Friction increased with temp, reaching a max between 200° and 400° F. The most highly chlorinated silicone compared well to a non-additive petroleum oil under favourable conditions. D. B. S.

730. Composition of lubricating oil. Use of newer separation and spectroscopic methods. F. W. Melpolder *et al.* *Analyt. Chem.*, 1956, **28**, 1936–45.—A study was made of the composition and physical properties of fractions separated from a solvent-refined heart cut oil. The oil charge was fractionated by means of 20-stage mol dist, silica-gel chromatography, and liq thermal diffusion to yield saturated fractions ranging from predominantly *iso*paraffins to multi-ring *cyclo*paraffins. Hydrocarbon-type analyses were determined by mass and u.v. spectrometry, and several mol structures were postulated from mass and i.r. data. One fraction which exhibited extreme physical properties was found to contain from 4 to 10 rings/mol. J. S.

731. Carrying the load. S. H. McAllister and S. J. Beaubien. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 59–66.—Recent trends in automotive and mechanical design have increased the need for lubricants with sufficient load-carrying capacity to be effective under conditions of boundary lubrication. The load-carrying capacity of an oil is determined by its visc–temp behaviour, chemical characteristics, and E.P. additive content. Active-sulphur E.P. additives in diesel lub oils prevent scuffing failures of piston rings, crowns, and skirts under the most severe conditions. E.P. additive hypoid differential gear oils can carry very high sustained loads without wear penalty.

The problem of valve-train lubrication failure, resulting from high-output overhead-valve engines, is complex because fatigue and scuffing are sensitive to the metallurgy of the parts, the operating conditions, and the geometry of design. Optimum designs and tailored lubricants are being developed by co-operative efforts of the petroleum and automotive industries, but a quick, final solution should not be anticipated because of the continuing trend to higher speeds and outputs. In industrial metal-working and metal-cutting operations, where boundary lubrication prevails, lubricants must be tailored to meet the individual requirements of each operation. Several examples are cited of the savings which may be achieved in both the automotive and industrial fields by the use of lubricants with suitable load-bearing properties.

(Authors' abstract.)

732. Detergent oils and their dispersive properties. J. Larbre. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1298–312.—Brief general discussion of properties and purpose of, and tests (particularly lab (non-engine) tests) applicable to, detergent oils; followed by a study of dispersant ability of such oils (numerous photomicrographs) with special reference to thermal flocculation tests; *e.g.* good oil still shows dispersion at 170° C, whilst poor oil can show total flocculation at 80° C. Paper is largely based (with some expansion) on work previously reported (*cf.* Abs. **1348**, 1955). V. B.

BITUMEN, ASPHALT, AND TAR

733. Precoated aggregates for surface treatments. Anon. *Rds & Str.*, 1957, **100** (1), 219.—Texas Highway Department increasingly uses precoated stone for surface treatments to solve problem of dusty aggregates and seal coating work.

Specifications and cost data are given. Other advantages claimed include no bleeding, greater yield of aggregate distribution—very little loss of aggregate, and bleaching out of colour to that of parent rock. Disadvantage is streaking of asphalt cements. G. A. C.

SPECIAL HYDROCARBON PRODUCTS

734. Volume changes in mixing hydrocarbons. J. F. Connolly. *Industr. Engng Chem.*, 1956, **48**, 813–16.—The mixing of *n*-butane with refined naphthas leads to a shrinkage in the total vol of material. Sp vol of the binary systems *n*-butane–benzene and *n*-butane–*cyclo*hexane and the ternary system were investigated using a glass pyknometer. The percentage vol changes for the 50–50 mixture in both binary systems varied from *ca* −0·4% at 60° F to −1·5% at 140° F. A method for predicting the ternary data is given. D. B. S.

735. Binary mixtures of naphthenes and aromatics. Vapour–liquid equilibrium data. H. S. Myers. *Industr. Engng Chem.*, 1956, **48**, 1104–8.—Equilibrium data at 760 mm pressure for the following systems are given: *cyclo*pentane–benzene, methyl*cyclo*pentane–benzene, benzene–methyl*cyclo*hexane, *cyclo*hexane–toluene, methyl*cyclo*pentane–toluene. All the systems showed considerable deviations from ideality, but only the methyl*cyclo*pentane–benzene system formed an azeotrope. Terminal activity coeff ranged between 1·2 and 1·4. D. B. S.

736. Temperature coefficient of resistivity of polythene and oil-impregnated paper. A. W. Stannett and D. H. Schroff. *Nature, Lond.*, 1957, **179**, 94.—For polythene cable and 2 oil-impregnated cables the resistivity R of the insulation varied with the abs temp T according to the relation $R = R_e \exp(b/T)$, where R_e and b are constants. Electrification times >1 hr were necessary before R for polythene approached a constant value. H. C. E.

737. Dependence of the electrical breakdown of transformer oil on electrode conditions. R. Hancox. *Nature, Lond.*, 1956, **178**, 1305.—Hemispherical electrodes of dia 2·5 cm were prepared before each measurement by polishing and buffing. The oil was filtered, dried, and degassed, and tested in an enclosed cell with a spark gap of 2·5 mm. For stainless steel the breakdown voltage increased from 1100 kV/cm when the electrodes were used immediately to >2000 kV/cm after they had been stored for >5 hr. Corresponding values for Al electrodes are 890 kV/cm and 1310 kV/cm after storage for >15 minutes. The variation was dependent only on the treatment of the cathode, and was not obtained if the electrodes were finally washed with hexane or acetone.

It is suggested that the effect is due to oxidn of the metallic surface during storage. An electrical double layer exists on the surface of the cathode of magnitude proportional to the thickness of the oxide film. This double layer hinders emission of electrons into the oil, and thus reduces the possibilities of breakdown. H. C. E.

738. Examination of oils from 220 kV mobile transformers. L. Maurer and T. Wörner. *Elektrotech Z.* **A**. 1956, **77**, 885–8.—24 transformers, rating 90–150 MVA, breather (silica gel) protected, of similar pattern and filled with the same oil, had oil samples withdrawn after operating periods of ½–16½ years. Comprehensive tests included sludge (0 in all cases), acid val (0–0·20), sap val (0·06–0·70), dielectric strength VDE (42–60), and dielectric loss factor, tan δ/70° C (1·1–>100%). For last measurement only, oils were filtered through No. 4 sintered filter at 1 mm. Thus values of tan δ indicate deterioration when all other usual tests (and also appearance) show but a slight degree of ageing. Measurement of i.r. spectra showed absorption at 1710 cm^{-1}, extent of absorption followed tan δ and suggests that both i.r. and p.f. measurement give sensitive indication of early formation of oxidn products, stable polar ketones, which are not easily further oxidized to acids. Clay treatment of such oils gives marked reduction in i.r. absorption and p.f., with little effect on acid val and sap val. It is recommended that transformer oil maintenance tests should include i.r. and p.f. measurements. V. B.

MISCELLANEOUS PRODUCTS

739. Urethane rubber from a polyether glycol. F. B. Hill *et al.* *Industr. Engng Chem.*, 1956, **48**, 927–33.—Adiprene B urethane rubber is an addition polymer based on organic di-*iso*cyanates and aliphatic polyethers. The rubber is considerably tougher and more stable to storage than commercial diene hydrocarbon polymers, and is soluble only in certain polar solvents. Adiprene B gum vulcanizates have good resilience, high tensile strength, resistance to oxygen and ozone attack, and a good combination of solvent resistance and low temp properties. Carbon black and silicates have been used effectively as reinforcers. Factors influencing the processibility are also discussed. D. B. S.

740. Surface treatment of hydrated silica pigments for reinforcement of rubber stocks. R. S. Stearns and B. L. Johnson. *Industr. Engng Chem.*, 1956, **48**, 961–3.—The introduction of organic groups on to a partially hydrated silica surface by reaction with silanes alters the chemical properties of the surface without changing the area. The use of silanes with finely-divided silica as a reinforcing agent for rubber stocks is described and the mechanism of the reaction discussed. D. B. S.

741. 2-methyl-5-vinylpyridine elastomers in oil resistant service. J. F. Svetlik, H. E. Railsback, and W. T. Cooper. *Industr. Engng Chem.*, 1956, **48**, 1084–9.—Some rubbers are not capable of withstanding the deteriorating action of diester lubricants at high temp. New rubbers based on copolymers of butadiene and 2-methyl-5-vinylpyridine (M.V.P.) and terpolymers of butadiene, acrylonitrile, and M.V.P. quaternized with organic halogen cpds are suitable for these applications, and in addition they have satisfactory properties at low temp. The effects of the compounding variables (quantity and type of quaternizer, type of reinforcer, etc.) and the pyridine content were studied. The compounded rubbers gave excellent resistance to swelling and cracking in diester oils at 158°–200° F and good resistance to ethylene glycol, amyl alcohol, acids, caustic, 2,2,4-trimethyl pentane-toluene, and ketones. They were superior to butadiene–acrylonitrile cpds in contact with hot diesters, giving a much higher tensile strength after exposure for 72 hr at 300° F or 48 hr at 158° F. The terpolymers were found to offer better resistance to aromatic hydrocarbons than the copolymers. D. B. S.

742. Rocket propellants. Various. *Industr. Engng Chem.*, 1956, **48**, 721–77.—15 papers on the subject, including the following topics: the use of polymers as binders; tetranitromethane as an oxidizer; concentrated hydrogen peroxide as a propellant; thermal decomposition of simple nitrite esters; nitrate ester flames and combustion; thermal decomposition of carbon-nitro cpds. D. B. S.

743. The British petroleum chemicals industry. R. F. Goldstein. *Inst. Petrol. Rev.*, 1957, **11** (121), 4–7.—The paper is concerned with petroleum-derived chemicals, synthetic rubbers, plastics, fibres, and detergents, and describes the current capacity and forecasts the expansion which will occur in the industry in the future. Tables are included showing the firms engaged in the industry and their products, 1953 oil cracking capacity, predicted capacity for olefin-derived chemicals, and the 1975 requirements of petroleum chemicals in the U.S.A. One ref. C. B.

744. The Gas Council's annual report. Anon. *Inst. Petrol. Rev.*, 1957, **11** (121), 17.—An account of some of the activities of the Gas Council, derived from the Seventh Report and

Statement of Accounts. The status of the search for natural gas, the North Thames Gas Board's investigation into the storage and handling of LPG, oil gasification, the use by the Gas Boards of refinery gases, and research on the hydrogenation of heavy oils are all briefly described. C. B.

745. Wax from South Africa. Anon. *Soap, N.Y.*, 1956, **32** (12), 182.—A Fischer–Tropsch type wax, Paraflint, made in Johannesburg by Sasol is now available in the U.S.A. 4 photographs of the plant are included. Paraflint is cheap. It differs from conventional paraffin waxes in its high-temp characteristics and in crystal size. M.p. is 215° F. Temp-hardness curves for various Paraflints are included. D. K.

746. Non-flammable paint strippers. Pt 3. Activators, thickeners, evaporation retarders, conclusion. B. Berkeley, D. Schoenholz, and M. Skrypa. *Soap, N.Y.*, 1956, **32** (11), 149.—The use of wax as evaporation retarders for paint removers is reviewed. An evaluation of various retarders was made, and data are tabulated. D. K.

CORROSION

747. An economic survey of underground corrosion preventive measures. D. C. Glass. *Proc. Amer. Petrol. Inst.*, 1955, **35** (V), 61–7.—A study of economic principles as applied to underground corrosion preventive measures in general cites maintenance cost and leak experience on a bare Texas Gulf Coast trunk pipeline, prior to application of cathodic protection and the fundamentals of operation of the system for 15 years. Data indicate that preventive measures for bare pipe are effective and less expensive for the first 15 years' operation than reconditioning, coating, and application of cathodic protection to supplement coating.

This paper also indicates results of a survey of 28 leading pipeline companies, reporting miles of pipe laid during the period 1930–55; type of protective coating used, if any; percentage of total length of lines protected by coating and for cathodic protection; cost of coating materials and application cost; average cost of power for cathodic protection by rectifier; estimated cost of protection by galvanic anodes on a per mile/year basis; and effectiveness of cathodic protection as indicated by leak experience. (Author's abstract.)

748. Corrosion rates directly measured. D. H. Stormont. *Oil Gas J.*, 21.1.57, **55** (3), 85.—An apparatus is described which employs a resistance measuring system which follows electrically the progress of corrosion on a probe by means of a special meter. Field tests show the method to be rapid and accurate. G. A. C.

749. Plastic tape tests show low current needs. M. E. Parker. *Pipe Line Ind.*, 1956, **5** (2), 44–5.—Field tests on Seadrift pipeline, S. Texas, show that a 12-mile test section of 8-inch line, coated with polyethylene tape, is being protected with a total impressed current of 74 mA in 1800 Ω-cm soil. The tests compare favourably with tests on an adjacent 18-mile section conventionally coated. R. T.

ENGINES AND AUTOMOTIVE EQUIPMENT

750. Future developments of the high-speed diesel engine. E. Chatterton. *Mot. Ship*, 1957, **37** (441), 450.—An extract of a paper read to the ASME, 25–30 Nov 1956. The author sets out to show that the development of the high-speed engine is justified on both technical and economic grounds. The lines of development which at present appear to offer the greatest possibilities for reduction of engine size and weight and the limits which exist are considered. An assessment is made of the relative suitabilities of various basic types of engine for such developments. D. K.

751. Analysis of CFR engines in Italy. G. Leidi and C. Siniramed. *Riv. Combust.*, 1956, **10** (12), 865–79.—A comparative analysis of the various CFR engines in Italy has been undertaken, fuel samples being periodically sent out for determination of the O.N. by the Motor Method and Research Method.

The trend of correlation over the years 1953–55 is reviewed on the basis of the following parameters: (1) number of tests made under non-standard conditions; (2) number of findings with deviations above ± 1 O.N. as compared with the average finding; (3) standard deviations calculated for the single circuits and for a whole year; (4) individual engine average standard deviation with due regard for their characteristic deviation.

It is shown that the O.N. assay has reached a better degree of precision. (Authors' abstract.)

752. The MAN-M procedure. J. S. Meurer. *Schweiz. Arch. angew. Wiss.*, 1957, **23**, 1–7.—Combustion phenomena in diesel engines are discussed, with especial reference to the relationship between mol size and oxidn rate of paraffins. Breakdown of fuel mol gives rise to products having improved anti-knock properties; soot is mainly formed in initial, not final, combustion stages. It is desirable to limit proportion of fuel self-ignited; to enable fuel to pre-oxidize without overheating; to restrict fuel–air mixing to vaporized fuel. MAN design of bowl-shaped combustion space in piston, and tangential fuel injection, giving $\frac{1}{10}$ mm film on cyl walls, largely enables these objects to be achieved. Comparison of combustion stages in conventional and MAN type engines is tabulated; in the latter only 5% of the fuel is sprayed into the air, the remainder being distributed on the walls of the combustion space. MAN motor will operate satisfactorily on fuels ranging from 86 O.N. (F_1) gasoline to SAE 10 lube. V. B.

753. Lube oil tests reveal engine ailments. J. L. Wilson. *Pipe Line Ind.*, 1956, **5** (1), 25–9.—Spectrographic analysis of lub oils indicates the condition of engines and compressors while still in operation. Analysis and identification of wear products and contaminants—accumulated in the oil—furnish information on general wear and wear of sp pt. Results promise reduced maintenance costs, greater engine availability, and more efficient use of maintenance labour. R. T.

754. Future trends in passenger-car design affecting fuels and lubricants. V. G. Raviolo. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 85–7.—Trend charts of past history are useless in predicting the future. The needs of the customer today and tomorrow will dictate car and petroleum requirements. There will be a much larger market, and it will be more difficult to satisfy as the range and variety of operating conditions multiply.

Permanently sealed wheel bearings are a real possibility. Improvement in axle performance will depend largely on lubricants, as higher loads and higher speeds generate higher surface stresses. Permanently sealed axles are definitely coming.

As engine power increases, the demands on the automatic transmission will also increase, and lubricants will be a decisive factor in determining the successful solution of the problem. The increasing use of hydrostatic systems for power steering and power brakes will create the need for hydraulic fluids with improved qualities.

Passenger-car engine h.p. will increase by as much as 30%

within the next few years. C.R. will be between 10 : 1 and 12 : 1, and the gasoline octane requirement will be over 100. The C.R. of low-priced cars will be substantially the same as the C.R. of high-priced cars. This will result in a narrow range of octane requirements which will probably be satisfied by marketing a single grade of gasoline by 1960–62.

Gas turbines will be in production by 1965 or sooner. The first application will probably be in a low volume speciality car in order to develop production methods and to test the market. Turbine fuel can be gasoline, but lower cost fuel will be expected. Volatility can be very low, and the dist range of the fuel fractions can extend into higher temp. Turbine operating temp will be as high as 500° F, and local metal temp can reach 650° F. It is probable that synthetic lubricants will be required. (Author's abstract.)

755. Past trends in the passenger-car design affecting fuels and lubricants. E. M. Johnson and C. W. Mortensen. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 75–84.—A review of passenger-car design and performance trends during the past 9 years shows an average C.R. increase of 6·7 : 1 in 1946 to 7·6 : 1 in 1954, the max being 9·25 : 1 to 8·7 : 1, a 50% increase in h.p.—from 105 to 151 h.p. While overhead valves and power brake systems did not add to the lubrication problems, the automatic transmission, hydraulic valve lifters, and power-steering gears demanded modifications and improvements in lubricant properties. General design trend towards higher output and smaller engines created many surface ignition problems, for which fuel composition was also partly responsible. The premium-grade fuels have been meeting continually the anti-knock requirements of the majority of the new cars, but regular fuels were satisfactory only until 1950, after which a gradual decline was noted until 1953. A sharp increase in the ASTM research O.N. of regular grade fuels in the early part of 1954 changed this situation. A general decline in vapour-lock incidence occurred in the post-war period, but the post-war level of vapour-lock incidence is higher than that for the corresponding pre-war period. A considerable gain in part-throttle fuel economy has been realized. Automatic transmissions caused the greatest change in operating temp, with a trend towards excessive temp over an increasing ratio of their full-throttle operating range. (Authors' abstract.)

SAFETY PRECAUTIONS

756. Treatment of tetraethyl lead poisoning. P. R. Boyd, G. Walker, and I. N. Henderson. *Lancet*, 1957, i, 181–5.—A brief review of TEL poisoning followed by reports of 4 cases in which, due to neglect of normal precautions, poisoning occurred in tank cleaners. Main feature of treatment was the use of a chelating agent (monoCadiNa complex of ethylene diamine tetraacetic acid) given intravenously and orally, and the effect of which in 3 cases was followed by a careful check of Pb excretion. Urinary Pb was greatly increased by intravenous, less so by oral medication, no effect on fæcal Pb. Fourth case, showing mental symptoms, was also greatly benefited by electro-convulsive therapy. V. B.

757. Refinery switchgears getting safer all the time. D. S. Brerton and J. Dunki-Jacobs. *Oil Gas J.*, 7.1.57, **55** (1), 102.—The API Recommended Practice for Classification of Areas for Electrical Installations in Petroleum Refineries (RP-500, First Edition Feb 1955) is discussed. Standard switchgear, both indoor and outdoor type, can be safely installed as close as 50 ft to source of potential hazard in freely ventilated process areas, or if installed in pressurized building, as close as 25 ft. Switchgear application, selection of substation, switchgear preference, power to work electrically-operated breakers, and trends in system protection are reviewed. G. A. C.

758. Industrial hygiene in the petroleum industry. J. W. Hammond. *Proc. Amer. Petrol. Inst.*, 1955, **35** (VI), 17–20.—The objectives of industrial hygiene are the prevention of disease and loss of efficiency through the control of occupational factors which may affect normal people. In the past, industrial hygiene practices were directed mainly toward the control of existing conditions. Today, engineering control features are applied to potential health hazards at the design or blueprint stage, and a number of procedures have been developed for evaluating problems which are not apparent or cannot be controlled at the design or development stages. Most of the occupational and health hazards found in the petroleum industry are not peculiar to it, and the experience gained in other industries can be applied directly in evaluating and solving its problems. Representative examples of probable chemical hazards, their sources, and extent in major developments of an oil company are listed.

(Author's abstract.)

759. Safety and service. O. Clarke. *Proc. Amer. Petrol. Inst.*, 1955, **35** (V), 21–3.—Although the oil industry provides a considerable share of its own transportation facilities, it also depends largely on public transportation and must be concerned with the serious problems facing all branches of public transportation. Competition among common carriers and with proprietary hauliers is in the public interest, but not if carried to the point where service is performed at a loss. Safety in the motor transportation of gasoline and other inflammable liq and compressed gases represents one problem requiring co-operation between the petroleum and transportation industries. An industry advisory panel with the API might help to solve this problem by providing better liaison with the Interstate Commerce Commission.

(Author's abstract.)

MISCELLANEOUS

760. Long range look ahead for oil and natural gas. C. J. Hedlund. *J. Petrol. Tech.*, 1956, **8** (7), 11–14.—In 1954 oil gave 44% and natural gas 24% of the total U.S. energy consumption. In 1955 U.S. oil consumption averaged nearly $8{\cdot}5 \times 10^6$ b.d., 70% more than in 1946, whereas in the same period the population had risen by 17%. Natural gas sales were $4{\cdot}2 \times 10^{12}$ cu. ft. in 1946 and 9×10^{12} cu. ft. in 1955, in energy equalling *ca* 55% of the total oil consumed.

Estimates regarding the future must take note of competitive fuels. In 1975 U.S. oil needs may be 15×10^6 b.d., and gas needs 18×10^{12} cu. ft. Hence in the next 20 years 85×10^9 brl of oil (over twice the present proved reserves) and 300×10^{12} cu. ft. of gas (1·5 times present reserves) are needed. For many years reserves have risen despite rising consumption rates, and the ratio of reserves to consumption has been fairly constant; the situation is similar for gas, but a measure of government control over gas prices is probably causing harm.

Oil reserves outside the U.S.A. are placed at $150–270 \times 10^9$ brl. Although the U.S.A. has spare producing capacity, in some areas imported crude would offer economic advantages, and if heavy fuel oil imports are restricted to prescribed levels a shortage of this commodity is likely on the East Coast. A sound import policy is needed to assure long range oil supplies for the U.S.A.

At least 100×10^9 brl of potential refined products are esti-

mated to be available from oil shale deposits in a limited area in NW. Colorado alone. The cost will be somewhat higher than for products from crude oil, while coal can give similar materials at higher costs. Oil shale products are unlikely to be important in the next 20 years. By 1975 some 11% of the electric power generated in the U.S.A. will come from atomic sources.

In 1955 world-wide capital investment in the oil industry was *ca* $\$8 \times 10^9$, 70% of this being in the U.S.A., while 60% of the total was on exploration and production. G. D. H.

761. European outlook good, but chemical industry's future depends on petroleum supplies. Anon. *Chem. Engng News*, 7.1.57, 55–8.—In spite of petroleum shortages, both the chemical and petroleum chemical industries are not being seriously hindered in production. However, indirect effects could be more far reaching. Diverting oil tankers round the Cape increases the voyage time by 50%, the average additional cost of oil being \$5·65/ton. How badly the chemical industry will be affected by a damaged general economy depends on how long it takes to clear the Suez Canal and to put the pipelines back into full operation. W. H.

762. Observations of a rubber man. E. J. Thomas. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 19–22.—The synthetic rubber industry, developed through co-operation among the oil, rubber, and chemical industries to meet the world war II emergency, has played an important part in the post-war increase in rubber consumption. Approx 2 million tons of natural and one million tons of synthetic rubber was consumed in the entire world in 1955, and world consumption will probably increase to 4 million tons p.a. within 10 years. In the present expanding economy, value is based not only on price and quality, but also on innovation, variety, convenience, payment terms, service, style, and reputation. Progress in marketing calls for imagination, consumer research, sales enthusiasm, and sales training. Among the personal factors subject to an individual's control—which largely determine his chances for success—are health, character, ability, teamwork, thrift, courage, and vision. (Author's abstract.)

763. Petroleum Division of the American Chemical Society. Anon. *Petrol. Times*, 18.1.57, **61** (1551), 69.—Abstracts are given of papers presented at Atlantic City, N.J., Sept 1956, and include use of hydrogen, polycyclic hydrocarbons, additives, and lubricants. G. A. C.

764. Roads to bigger markets. J. E. Buchanan. *Proc. Amer. Petrol. Inst.*, 1955, **35** (II), 15–18.—Petroleum asphalt provides a highway pavement which is superior to rigid concrete and considerably less expensive. For the parent petroleum industry, concerned about steadily rising gasoline taxes to pay for road construction, this is the solution to a dilemma. New and improved highways must be built to accommodate the millions of additional vehicles which will furnish the expanding market for motor fuels and lubricants. But these highways must be built without adding unnecessarily to the gasoline tax burden. Only economical asphalt paving can provide with tolerable tax burden these roads, so vital to the well-being of the petroleum industry. (Author's abstract.)

765. Petroleum financing. L. F. Terry. *Proc. Amer. Petrol. Inst.*, 1955, **35** (VI), 92–7.—The American petroleum industry has shown great progress since the depression of the early thirties. By years of concerted effort in the establishment of state production controls, inter-company co-operation and advances in petroleum engineering, the industry has attained a high degree of stability, which has greatly improved its credit rating in the eyes of bankers and other lenders.

The paper reviews some of the developments which have led to the higher order of credit accorded the industry, particularly the oil and natural gas producing business; it then describes how one of the petroleum banks appraises petroleum financing problems; finally, it considers the growth prospects of the industry and the future financing which this will require. (Author's abstract.)

766. An appraisal of future energy demand and supply in the United States. A. Cadle. *Proc. Amer. Petrol. Inst.*, 1955, **35** (VI), 76–81.—This paper presents an appraisal of the future energy picture in the U.S.A. to the year 1975, as it presently appears to be evolving. It further dwells upon that portion of the energy pattern which represents petroleum and, by way of example, on what this means to purchasing men with respect to the industry's future needs for steel.

The U.S.A.'s rapidly growing population and increasing appetite for energy will require petroleum, natural gas, coal, and other fuels which, in total consumption, should more or less double that of the present by the year 1975.

To explore for, develop, refine, and transport the crude oil which will be needed will require a redoubling of the physical, financial, and scientific efforts put forth in recent years. Authorities agree that the underground supplies exist. History proves that supplies are made available to consumers as requirements develop. Likewise, such allied industries as steel will continue to lend invaluable assistance to the industry's expansion.

The new forms of energy which are beginning to enter the picture, atomic fission, nuclear fusion, and solar energy, will be required to ease the problem of fully meeting demands as the years go by. It is fortunate for the future standard of living that these supplementary forms of energy are now coming over the horizon.

For a long time to come, the industry must continue its ceaseless growth towards a future out of all proportion to the petroleum industry known today. (Author's abstract.)

767. Oil in the total energy market. N. B. Guyol. *Proc. Amer. Petrol. Inst.*, 1955, **35** (VI), 63–70.—Details are given in this paper of the differences between energy consumed and work performed, and future market demand is estimated on the basis of the useful energy obtained, rather than total energy consumption. From 1937 to 1954, useful consumption of energy from all sources increased at a rate of *ca* 4% p.a., the same as gross national product during that period. The market for oil and gas has developed at a somewhat higher rate because these fuels have been displacing other sources of energy. As the displacement process nears completion, future rates of development in oil and gas sales may be expected to fall towards the 4% level. The market for dist of petroleum, which has been growing at the rate of 7% p.a., may be expected to slow to a growth rate of 5% p.a. by 1960. Within this group a shift is expected away from the lighter dist towards the middle dist. The market for residual fuel oil will depend almost entirely on its competitive price position. The market for natural gas, which has been expanding at a rate of 8½% p.a., will undergo a modest decline.

Future energy requirements in electric power generation, home heating, inland and overseas transport, agriculture, and industry are discussed separately. (Author's abstract.)

768. What engineers are asking about flow testing. Anon. *Pipe Line Ind.*, 1956, **5** (1), 22–4.—Questions put at the 11th Annual Short Course in Gas Technology at Texas A & I are answered by a panel of industrial leaders. R. T.

769. Ethylene, derivatives still on move. Anon. *Oil Gas J.*, 28.1.57, **55** (2), 178.—A review is given of the petroleum chemical industry and trends. Production in 1956 was 34 billion lb, and a rise is expected in 1957. More ethylene plants are being erected in the U.S.A. G. A. C.

770. The role of oil in the Soviet economy. II. Anon. *Petrol. Times*, 1.2.57, **61** (1552), 107.—This article concludes

extracts made from a comprehensive study of Russian oil recently published by the Petroleum Industry Research Foundation. Incorporation of Russian oil, Russia's tanker fleet, refineries, oil consumption, imports, and exports are dealt with, and a map illustrates the article. G. A. C.

771. TGT training programme pays off. D. E. Lambert. *Pipe Line Ind.*, 1956, **5** (2), 34–7.—A detailed report of the training of operating personnel in the gas transmission industry—equipment and machines, overall TGT operations, and the story of pipelining. R. T.

772. Selecting the valve for the job. Anon. *Brit. Chem. Engng*, 1956, **1** (1), 20–3.—To assist in choosing the correct valve for a sp purpose, materials commonly used in valve manufacture and applications are tabulated. An extensive table gives data on valves—with illustrations of some typical ones—available for use in the chem industry. Points to be considered when choosing a valve are discussed. R. T.

773. The activities of the API Medical Advisory Committee. C. M. Saunders. *Proc. Amer. Petrol. Inst.*, 1955, **35** (VI), 11–12.—During the past 10 years the API Medical Advisory Committee has served as a clearing house for medical directors and their technical advisers and has conducted much research on potential health problems associated with the production, transportation, refining, and marketing of petroleum and its products. Studies have included the toxicology of fluorides, the experimental production of skin cancer in mice by certain petroleum fractions, dermatitis, basic skin physiology, and the toxicity of C_9–C_{12} aromatics.
(Author's abstract.)

774. Oil legislation in Libya. Anon. *Petrol. Times*, 18.1.57, **61** (1551), 57.—Essential features of the new petroleum law are outlined, the petroleum zones, preliminary reconnaissance permits, concessions, fees for concessions, working obligations, and comparison with other countries. A map and chart show concessions in Libya granted by the Petroleum Commission. G. A. C.

775. Air pollution and the oil industry. L. B. Hitchcock. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 150–4.—While most of Los Angeles' air pollution is traceable to petroleum products, by far the largest share arises from the use to which these products are put. Motor-vehicle exhaust accounts for the largest single source of pollution. Fuel oil and gas also contribute. Incineration of refuse and metallurgical and miscellaneous industrial emissions account for most of the balance. The public, through its motor vehicles and rubbish burning, contributes more than half the total pollution.

The oil industry, indispensable to the community's growth, has done more than all the rest of the area in developing and adopting corrective measures, and has reduced its emissions very substantially. Petroleum production in Los Angeles County contributes a very minor part to air pollution.

Hydrocarbons and nitrogen oxides in combination produce smog effects, although neither alone, at concn found, is known to be deleterious.

Cleaner air costs money, but less than smog. Intensive application of science and engineering to the overall problem is the only road to success. (Author's abstract.)

776. Some aspects of energy trends. J. E. Warren. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 58–62.—3 significant developments relating to energy supply received impetus as a result of operations in the Texas Panhandle. They were: (1) the introduction of engineering management in oil and gas property operations; (2) its important role in the application of "proration" and "ratable take" policies as workable production concepts to accomplish conservation; and (3) the origin of long-line gas transmission as a means of energy supply.

The exploratory efforts necessary to maintain natural gas and crude oil supply are largely inseparable and interdependent. As each product of petroleum became valuable, it contributed its share to the total supply effort in proportion to its availability and competitive value. It is important that natural gas production fits into this pattern and is not subject to unrealistic regulations which will stifle the supply effort.

Aspects of changes in energy supply and utilization are discussed as follows: (1) legislative or regulatory freeze through "end use" control which would impede enterprise and competition; (2) technological advancements in refining practices, resulting in a higher yield of products with a greater value; (3) the need to recognize and adjust for the increasing swings in seasonal demand; (4) the continuing trend for increasing energy supply in the future; (5) changes in the role of different energy sources in the past and the expectation of notable changes to occur in the future; and (6) atomic energy at its present stage of development.
(Author's abstract.)

777. Management potential at the market place. O. C. Roehl. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 29–34.—Management potential is a most important factor in security analysis. *Who* is behind a balance sheet is usually more important than *what*. The quality of a company's management is reflected in the price of its securities. Programmes for development of future management are important, but present management also requires attention. Top management must devote its own time and effort to the problem. Management development programmes encompass both external and internal activities and once established, must be allowed to produce. Development of future management is more important than its evaluation in the securities market—it is a fundamental need of the U.S. economy. The country's whole way of life, and its future progress, is dependent on the quality of the nation's management. (Author's abstract.)

778. The past and future of API standards on oilfield equipment. J. R. Sumar. *Proc. Amer. Petrol. Inst.*, 1955, **35** (IV), 20–3.—Orderly operations where previously only chaos prevailed are, in part, a direct result of API standardization. Type standardization and interchangeability of the product of different manufacturers brought about an industry economy that has been, and will continue to be, beneficial to all having an interest in the oil business. API standards are international in scope, and the work of the standardization committees in keeping abreast of advancements in oilfield operations continues to be dynamic. The need for co-operation between the standardization agencies concerned with international standards on oilfield equipment, for the purpose of promoting the use of approved international standards, is urgent in the interest of the successful development of oil properties throughout the world. (Author's abstract.)

779. Current news. Anon. *Nafta* (*Krakow*), 1955, **11**, 173–4.—Completion of plan for the first half year 1955: crude—101·6% (3 days early); natural gas—106·3% (12 days early); gasoline—109·2% (15 days early). Production costs were below figures planned by 8%, 4%, and 3% respectively. In refining, difficulties were created by irregular deliveries and lack of experience. Even so, plan was exceeded by 1·3% and production for Jan.–June 1954 by 6%. In detailed figures: petrol—102·9%; fuel oils—99·4%; lub oils—109·0%; wax—104·0%; asphalt—102·0%; greases—102·0%; regenerated oils—99·0%.

In future Geological Documentation Bureau will retain all drilling logs and cores. M. S.

BOOK REVIEWS

Friction and Lubrication. F. P. Bowden and D. Tabor. London: Methuen, 1956. Pp. x + 150. 10*s.* 6*d.*

During the last 20 years Bowden and his co-workers at Cambridge have made a considerable contribution to the knowledge and understanding of friction and lubrication. In 1950 Bowden and Tabor gave a detailed account of work in this field in "The Friction and Lubrication of Solids," which was published as an International Monograph on Physics. The book under review may be regarded as a pocket edition of the larger work brought up to date. Although most of the work described was carried out at Cambridge, the authors have included the results of others wherever relevant. They have succeeded in compressing a very large amount of material into a small volume, and at the same time have presented a coherent and lucid account of the many aspects of frictional phenomena. Their object was to provide a brief account of modern work and views on the mechanism of friction and lubrication for engineers, physicists, metallurgists, students, and practical people who wish to become familiar with the basic ideas in this field.

This book deals first with the friction between unlubricated surfaces and the importance of the nature of the surfaces, the areas of contact between them, hardness, and oxide films. The surface temperature between rubbing solids is next dealt with, followed by the friction of non-metallic solids, such as PTFE, diamond, graphite, and molybdenum disulphide. A chapter is devoted to recent work on rolling friction showing the importance of the hysteresis losses. This is followed by a simple account of hydrodynamic lubrication. Work on boundary lubrication and the part played by adsorbed films and soaps formed by fatty acids reacting with the metal surfaces is described, and is followed by a chapter on the so-called extreme pressure lubrication.

In the opinion of the reviewer the authors have admirably achieved the object stated above. J. J. F.

Flow of Natural Gas through Experimental Pipe Lines and Transmission Lines. R. V. Smith, J. S. Miller, and J. W. Ferguson. U.S. Bureau of Mines Monograph 9. New York: American Gas Association, 1956. Pp. 89. $2.50.

The study reported here was carried out jointly by the Bureau of Mines and the AGA. Transmission factors for turbulent gas flow were determined in pipes of various diameters, and relationships were established with such variables as Reynolds number, absolute roughness, and internal radius. These relationships were used to develop methods for designing long transmission lines.

10 Years of PAR Research. New York: American Gas Association, 1956. Pp. 54.

A comprehensive list of publications under the PAR-sponsored research programme during the period 1944–54. As the foreword states, the published reports "deal with the industry's problems from the pressure in the bottom of the natural gas well to the draught in the customer's chimney." The publications are listed by subject, and abstracts are given.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

000 PETROLEUM INFORMATION BUREAU. Facts about petroleum. London, PIB, *In progress.*

000 TRUTER, E. V. Wool wax: chemistry and technology. London, Cleaver-Hume, 1956. 378 p.

020 AMERICAN GAS ASSOCIATION. Ten years of PAR research: a catalogue of research publications. New York, AGA, 1955. 54 p.

020 INSTITUT FRANÇAIS DU PÉTROLE. Rapport annuel 1955. Paris, IFP, 1956. 54 p.

030 MINISTRY OF SUPPLY. *Chemical Inspectorate.* Chemical service in defence of the realm: one hundred years of chemical inspection, the story of the Chemical Inspectorate, by W. G. Norris. London, Min. of Supply, 1957. 91 p.

080 BRITISH PETROLEUM CO. LTD. News in pictures 1956. London, BP, 1956. 40 p.

080 ENTE NAZIONALE IDROCARBURI. Annual report and balance sheet, 30th April 1956. Rome, ENI, 1956. 157 p.

080 LOUDON, J. H. Royal Dutch Petroleum Company, address given to the New York Society of Security Analysts, January 8, 1957. The Hague, Royal Dutch Pet. Co., 1957. 20 p.

090 ALUMINIUM DEVELOPMENT ASSOCIATION. Aluminium—production of castings: wall chart no. 4 and teachers' notes. London, ADA, 1956. 35 p.

090 AMERICAN PETROLEUM INSTITUTE. Research and development expenditures and personnel in the oil industry. New York, API, 1956. 7 p. (Oil industry background information bulletin no. 14.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for bolted production tanks. 9th ed. New York, API, 1956. 19 p. (API Std 12B.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for large welded production tanks. 6th ed. New York, API, 1956. 15 p. (API Std 12D.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for small welded production tanks. 3rd ed. New York, API, 1956. 15 p. (API Std 12F.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for wooden production tanks. 6th ed. New York, API, 1956. 15 p. (API Std 12E.)

090 BRITISH STANDARDS INSTITUTION. Cylindrical land steam boilers of welded construction (other than water-tube boilers). London, BSI, 1956. 128 p. (BS 2790: 1956.)

090 OIL COMPANIES MATERIALS COMMITTEE. Specification for industrial medium voltage grouped motor starter boards. London, OCMC, 1955. 9 p. (Spec. no. ELEC 3.)

090 OIL COMPANIES MATERIALS COMMITTEE. Specification for underground lead covered and armoured cables protected against corrosive attack. London, OCMC, 1957. 4 p. (Spec. no. ELEC 4.)

090 ORGANISATION FOR EUROPEAN ECONOMIC CO-OPERATION. Joint action by OEEC countries in the field of nuclear energy. Paris, OEEC, 1956. 170 p.

115. TRINIDAD AND TOBAGO. *Petroleum Department.* Administration report of the petroleum department for the year 1954. Trinidad, Government Printer, 1956. 26 p.

144 METRE, W. B. Petroleum industry in India. Calcutta, Geol. Mining and Metall. Soc., 1956, 6 p. Presidential address at the 32nd annual general meeting of Geological, Mining and Metallurgical Society of India, on 28th September 1956.

159 COLONIAL GEOLOGY AND MINING RESOURCES. The East African rift system, by F. Dixey. London, HMSO, 1956. 71 p. (Bulletin supplement no. 1.)

159 UGANDA. *Geological Survey*. Oil in Uganda, by N. Harris, J. W. Pallister and J. M. Brown. Entebbe, Government Printer, 1956. 33 p.

220 PHILLIPS, C. Gas chromatography. London, Butterworths, 1956. 113 p.

260 INSTITUTE OF PETROLEUM. Standard methods for testing petroleum and its products (excluding engine tests methods for rating fuels). 16th ed. London, IP, 1957. 795 p.

270 AMERICAN SOCIETY FOR TESTING MATERIALS. 1956 supplement to book of ASTM standards including tentatives. Part 5. Fuels, petroleum, aromatic hydrocarbons, engine antifreezes. 325 p. Part 6. Plastics, electrical insulation, rubber, electronics materials. 368 p. Philadelphia, Pa., ASTM, 1956.

300 BRITISH PETROLEUM CO. LTD. The search for oil. London, BP, 1957. 24 p.

400 TULSA PUBLIC LIBRARY. Off-shore operations. Tulsa, Okla., Public Library, 1956. 27 p. (Petroleum bibliography no. 37.)

420 TIRASPOLSKY, M. W. Depuis le turbo-forage. Paris, AFTP, 1956. 22 p. Paper given to the Association des Techniciens du Pétrole on 14 May 1956, and reprinted from Bull. A.F.T.P. no. 118, 31 July 1956.

420 TIRASPOLSKY, W. Le turboforage : premiers résultats, premiers objectifs. Bordeaux, Imprimerie Bière, 1956. 21 p. Reprinted from Compte rendu des journées d'études pétrolières, Bordeaux, May 25–27, 1956.

430 AMERICAN PETROLEUM INSTITUTE. Bulletin on high-pressure thread compounds. 2nd ed. New York, API, 1956. 2 p. (API Bul 5A2.)

430 AMERICAN PETROLEUM INSTITUTE. Bulletin on performance properties of casing and tubing. 6th ed. New York, API, 1956. 11 p. (API Bul 5C2.)

530 WITHERSPOON, P. A. Importance of water flooding in Illinois; and, Pakota Benoist water flood, Illinois. Urbana, Ill., State Geological Survey, 1955. 8 p. Reprinted from the Oil and Gas Compact Bulletin, 1955, **14**, June, no. 1, p. 114–21.

610 KING, G. A. B. Tanker practice : the construction, operation and maintenance of tankers. Wokingham, Maritime press, 1956. 148 p.

610 NATIONAL PETROLEUM COUNCIL. Interim report of the working group of the National Petroleum Council's committee on tanker requirements. Washington, D.C., National Petroleum Council, 1956. 9 p.

610 UNITED STATES. BUREAU OF MINES. Crude-oil and refined-products pipeline mileage in the United States, January 1, 1956, by A. T. Coumbe and I. F. Avery. Washington, D.C. U.S. Dept. Interior, 1956. 8 p. (Information circular 7769.)

620 UNITED STATES. BUREAU OF MINES. Flow of natural gas through experimental pipe lines and transmission lines, by R. V. Smith, J. S. Miller and J. W. Ferguson. New York, American Gas Association, 1956. 98 p. (Bureau of Mines monograph 9.) This paper presents results of the work done in co-operation with the Pipeline Research Committee of the American Gas Association and the State of Oklahoma.

640 FIRE PROTECTION ASSOCIATION. Buildings for the storage of flammable liquids. London, FPA, 1957 ? 2 p. (TIS 3002.)

640 FIRE PROTECTION ASSOCIATION. Fire precautions on farms. 1. Storage of petrol, oil and other liquid fuels. London, FPA, 1957 ? 2 p. (TIS 1004A.)

720 KELLOGG COMPANY, THE M. W. Solvent decarbonizing. New York, Kellogg, 1956. 16 p. (Kellogram no. 3, 1956 series.)

720 OTHMER, D. F. *ed.* Fluidization. New York, Reinhold, London, Chapman and Hall, 1956. 231 p.

740 COMBES, J. J. Continuous analysis. New York, Kellogg, 1956. 6 p.

740 ROSE, H. E. *and* WOOD, A. J. An introduction to electrostatic precipitation in theory and practice. London, Constable, 1956. 166 p.

750 FLETCHER MILLER LTD. Cutting fluids. 5th ed. Hyde, Fletcher Miller, n.d. 63 p.

760 AIR POLLUTION FOUNDATION. Analysis of air near heavy traffic arteries, by N. A. Renzetti. Los Angeles, Calif., Air Pollution Foundation, 1956. 28 p.

*760 DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE JOINT FIRE RESEARCH ORGANIZATION. The production of foam for injection at the base of petrol tanks, by R. J. French and P. L. Hinkley. Boreham Wood, DSIR, 1956. 11 p.

760 FIRE PROTECTION ASSOCIATION. The fire hazard of static electricity. London, FPA, 1956. 12 p. (Booklet no. 29.)

*810 BRITISH IRON AND STEEL RESEARCH ASSOCIATION. The rate of fuel and air mixing in a model of an oil fired open hearth furnace, by M. P. Newby. London, BISRA, 1952. 7 p.

*810 BRITISH IRON AND STEEL RESEARCH ASSOCIATION. Visit to Forges d'Hennebont to inspect the compressed air installation for atomising fuel oil, by R. Mayoreas. London, BISRA, 1956. 4 p.

810 EMMERSON, B. P. *ed.* Fuel injection systems. 3rd ed. New York, Diesel Publications, 1956. 198 p.

810 INSTITUTE OF FUEL. Special study of domestic heating in the United Kingdom—present and future, proceedings of the conference held at Westminster, 1956. Vol. 2, including certain papers received too late for inclusion in Vol. 1. London, Institute of Fuel, 1956. 105 p.

830 BOWDEN, F. P. *and* TABOR, D. Friction and lubrication. London, Methuen, New York, Wiley, 1956. 160 p.

910 OIL AND GAS JOURNAL. Power requirements in the U.S. oil and gas industry 1956–1960, by W. H. Stueve. Tulsa, Okla., Oil and Gas J., 1956. 9 p.

930 ESSO PETROLEUM CO. LTD. Careers at Fawley Refinery for science and engineering graduates. Fawley, Esso, 1956. 31 p.

960 AMERICAN PETROLEUM INSTITUTE. Session on weather forecasting. New York, API, 1956. 50 p. Preprints of papers given at the 36th Annual Meeting, Chicago, Ill., November 12, 1956.

990 OIL AND GAS JOURNAL. Forecast of activity in the oil and gas industry 1956–1960, by J. C. Casper. Tulsa, Okla., Oil and Gas J., 1956. 20 p.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

780. Factors in age determination of carbonate sediments by thermoluminescence. E. J. Zeller, J. L. Wray, and F. Daniels. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (1), 121–9.—New data obtained from pressure experiments have shown that at least 2 genetic types of thermoluminescence exist and have furnished an objective means for the selection of limestone samples for age determination tests. The quantity of γ-radiation necessary to reproduce the natural thermoluminescence of a sample can be determined experimentally. When this value is divided by the natural radiation rate, an

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index is obtained which bears a linear relationship to geologic age. Possible sources of error have been recognized, and their effects are discussed. E. N. T.

781. Experimental deformation of sedimentary rocks under confining pressure tests at room temperature on dry samples. J. Handin and R. V. Hager, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (1), 1–50.—The fact that rocks become stronger and more ductile as the mean pressure is raised has been known for many years, but only a few different rocks have been tested under conditions corresponding with those existing in the crust and depths reached by the drill. In this paper are recorded the results of triaxial compression tests on 23 dry rocks at room temp and at various confining pressures ranging from 0 to 2000 atm. Stress–strain curves and curves for ultimate strength and ductility as functions of confining pressure are given for each rock, and some generalizations are made for every rock type investigated. In all tests, marked increases in strength and ability to deform permanently without fracturing were found.

It is planned to include studies of the effects of temp, time, and interstitial solutions, and it is hoped that ultimately it will be possible to predict the mechanical properties of sedimentary rocks deeply buried in the earth's crust.

E. N. T.

782. Recent sedimentological progress and its application to petroleum research. (In French.) A. Vatan. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 5–17.—Following a resolution of the Third World Petroleum Congress which recommends that the sedimentological researches should be developed, the author reviews the works carried out on this subject during the last few years. First, he examines the studies concerning the recent sedimentation by considering different types of sediments, then he summarizes the works on sedimentary petrography concerning the ancient sediments. Considerable progress has been accomplished in the technical field (X-rays, spectrography, isotopes). The application of sedimentology to petroleum researches is finally considered. The necessity for the petroleum industry to promote these researches is emphasized, and the wish is expressed for a better co-ordination and a closer co-operation between the geophysical and reservoir engineering departments. (Author's abstract.)

783. The cementation of oil reservoir sands and its origin. C. A. Fothergill. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 301–14.—An investigation of the mineral cementation of oil reservoir sands from Venezuela has shown that there are marked patterns of cement development in lenticular sands within a sand–shale series. A number of different cements, whose sequence can be established, have been introduced into the sands as a result of post-depositional sedimentary processes, and it can be shown that, in respect of the carbonate cements (calcite, dolomite, and ferro-dolomite) there is a marked increase in cement content vertically towards sand–shale contacts and there is evidence of a tendency towards an increase of cementation near the feather-edges of the lenses. A physico-chemical mechanism, involving ionic impedance across shale barriers during the compaction phase, is proposed to account for these patterns of cement development, and evidence for this is presented. Inasmuch as the introduction of cement into a reservoir sand modifies its primary porosity and may alter appreciably its permeability, the role of cementation in oil geology is of both fundamental and practical importance, especially with regard to migration and the storage of oil in lenticular sands.

(Author's abstract.)

784. Location of petroleum accumulation by facies studies. L. L. Sloss. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 315–35.—Facies are treated as lateral or areal variations in the aspect of stratigraphic units. Analysis of sedimentary data from outcrops, cuttings and cores, and mechanical logs makes possible the derivation and numerical expression of a number of sedimentary aspects and the construction of a variety of quantitative facies maps. Certain sedimentary aspects yield facies maps which may be directly interpreted in terms of possible oil accumulation, while the mapping of other aspects leads to a greater understanding of a particular area, and, indirectly, to an estimate of petroleum potentialities. Facies studies in oil exploration may be considered at 4 levels, each succeeding level of analysis bringing to bear a greater concn of data and an increased attention to detail: (1) regional studies, involving entire depositional provinces or parts of neighbouring provinces; (2) semi-regional, or "basin," studies, directed toward the estimate of possibilities of extension of productive trends within a single sedimentary basin; (3) district studies, designed for the development of new pools or the discovery of untapped potential zones within oil-producing areas; (4) pool studies, which apply the great wealth of available data to the expansion of known oil pools or the discovery of further accumulations, particularly where non-structural traps are involved. (Author's abstract.)

785. Status of our present information on the origin and accumulation of oil. P. V. Smith, Jr. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 359–76.—In past years, theorizing on the origin of petroleum has been influenced greatly by the fact that liq hydrocarbons had never been detected in recent sediments. It has been widely proposed that petroleum was formed from the original "complex organic matter" through such agencies as bacteria, radioactiviy, catalysis by the sediments, and possibly heat or pressure over indeterminate periods of time. In order to learn about the nature of the organic matter in recent sediments, a wide variety of fresh, brackish, and salt water deposits have been studied. In every case, paraffinic, naphthenic, and aromatic hydrocarbons have been detected. The quantities of such materials have varied from as little as 9 parts to as much as 11,700 p.p.m. of dried sediment. An estimate of 10,400,000 brl of crude oil/cu. mile of sediments was obtained for a location off the coast of Louisiana by extrapolating core data, even though sediments in this area are characterized by relatively low organic carbon contents. Carbon 14 analyses have established the recent origin of these hydrocarbons. Possible sources of this "young petroleum" are discussed.

(Author's abstract.)

786. Interstitial water of oil-bearing sands and sandstones. W. von Engelhardt. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 399–416.—The irreducible water saturation in beds of glass spheres, as obtained in the capillary pressure cell with different interfacial tensions, contact angles, and specific gravity differences, is investigated theoretically and by experiments. The true capillary pressure function is calculated for pendular water rings at the contacts of spheres. In natural sandstones pendular water at grain contacts and water films on the inner rock surface are distinguished. The dependence of these 2 kinds of irreducible water on the nature of displacing fluid is discussed. The possibility of transport phenomena in the water films as viscous flow, electrical conductivity, and diffusion is investigated.

(Author's abstract.)

787. Correlation of geological horizons on the basis of physico-chemical properties of crude. J. Pohl. *Bull. Polish Inst. Petrol.*, 1955, **5**, 9 (suppl. to *Nafta (Krakow)*, 1955, **11**).—Work in this field has been neglected in Poland since 1936. More recently new field "Folusz-Pielgrzymka" provided an opportunity for fresh start. Only sp. gr., % paraffins, visc, pour point, and Engler dist were done. 86 samples were tested. In 1955 3 more fields were investigated, and 4 more are to be included soon. M. S.

788. Chemical characterization of aqueous levels of Miocene and Oligocene. W. Chajec. *Bull. Polish Inst. Petrol.*, 1955, **5**, 9–10 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—As a part of a general scheme of identification 1200 analyses have been done. Average composition of Miocene and Oligocene waters from 7 areas are given in tables. Exceptional quantity (144 mg/litre) of iodine has been found in Skoczow area.

M. S.

789. Progress of regional sedimentology. D. J. Doeglas. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 417–26.—Several new and partly unpublished studies on the regional sedimentology of sediments of the Rhine and Rhone rivers, the delta of the Rhone and Orinoco, the Gulf of Paria, the shelf around Trinidad, and environments in the Netherlands are briefly discussed. These studies include the regional distribution of mineral associations, size frequency types, microfauna, and other properties of importance for the determination of facies. The value of regional studies with detailed mapping and sampling and the use of uniform techniques are pointed out. (Author's abstract.)

790. Significant advances and trends in palæontology, including recent advances and trends in ecology. M. A. Hanna. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 453–71.—Views regarding the relationship of palæontology to biology and stratigraphy are cited. Some problems in palæontology, particularly in taxonomy, nomenclature, and the separatist tendency, are pointed out, together with trends towards their solution. Advances and trends in descriptive palæontology cited include codification of existing data; accelerated studies of long studied groups; and the "explosive" acceleration in the study of minute fossils such as spores, pollen, hystrichospherids, discoasters, etc. Some advances and trends in neoecology are reviewed, and in palæontology some applications are indicated. Increased use of statistical methods is cited. References to some new techniques are given. A part of the stimulus for advances and trends in palæontology and ecology is the expanding study of recent sediments and need for greater stratigraphic detail. (Author's abstract.)

791. The ratio between pelagic and benthonic foraminifera as a means of estimating depth of deposition of sedimentary rocks. T. F. Grimsdale and F. P. C. M. van Morkhoven. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 473–91.—Counts of pelagic and benthonic foraminiferal populations from the floor of the NW. Gulf of Mexico have been plotted as percentages of total populations in order of depth, both along the 12 individual traverses collected and in a combination chart. From the latter, 2 moving average curves have been computed by different methods, and histograms drawn at 10% intervals to show the distribution in depth of the various pelagic–benthonic ratios. These histograms may provide an approx method of estimating the absolute depth of deposition of foraminiferous sediments in Cretaceous and Tertiary open marine sequences; it is considered probable that moving average curves similarly constructed from counts of fossil material will provide a means of determining the trends, from deep to shallow or shallow to deep water deposition, in a succession of foraminiferous rocks where pelagic and benthonic foraminifera occur in association. The importance of extending these studies is emphasized, in order to confirm or to disprove the validity of this method. (Authors' abstract.)

792. Stratigraphic correlation of Upper Cretaceous and Lower Cretaceous in the Tethys and Boreal by the aid of microfossils. F. Bettenstaedt and C. A. Wicher. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 493–516.—Stratigraphically most important are the following microfossils: the foraminifera in the marine complex, the ostracods in the brackish and fresh water complex, and the spores in the terrestrial complex. Due to the indenting of these facies, on the basis of these microfossils, it will be possible in the future to establish a worldwide correlation comprising all facies. This time only a small part is being dealt with, namely, some marine small foraminifera of the Cretaceous. In the course of intensive drilling for petroleum a reliable micropalæontological subdivision of the Cretaceous controlled by magafossils was established in N. Germany. Samples from other countries proved that many index fossils do also occur beyond Germany in almost all European countries, in Israel, Egypt, Morocco, the U.S.A., Mexico, and Trinidad. Of greatest importance is the ecological difference between cretaceous sediments of the Tethys and the Boreal. The species occurring in both facies show the same vertical range and sequence almost everywhere. This applies especially to those species whose phylogenetic development is known. In order to use foraminifera for universal correlations their stratigraphic distribution should, with the help of accurately horizonted samples, be fixed, and the same species should everywhere be given the same specific name. There are 3 examples chosen out of many others to demonstrate the obvious likenesses. The reasons for the confusion in taxonomy and nomenclature of foraminifera are to be seen in the neglect of the extensive literature, and in inadequate figures, but chiefly, however, in the insufficient knowledge of the width of variation. According to observations of the writers, minor differences of the width of variation of the individual species permitting the establishing of subspecies (geographic races) are only found when comparing fauna of the same geological age from far distant localities. By that, worldwide fossils may everywhere retain the same specific name, a factor that facilitates stratigraphic comparison and simplifies complicated systems (ternaer nomenclature). On 2 stratigraphic tables a certain number of index fossils of the marine small foraminifera are presented. They are species with worldwide distribution occurring simultaneously in the Boreal and the Tethys, or such species discovered in the Boreal only or in the Tethys only, occurring, however, universally within these facies. Special importance is put on benthonic foraminifera by reason of stressing their usefulness for the establishing of worldwide correlations. Short explanations are given for the 55 foraminifera species (31 in the Upper Cretaceous and 24 in the Lower Cretaceous) as to their stratigraphic and geographic range. 24 species are figured on 3 fossil-plates. (Authors' abstract.)

793. Micropalæontological studies of the Cretaceous–Tertiary boundary. J. Cuvillier *et al.* *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 517–44.—In each region examined where homogeneous sedimentation has continued without a break since the end of the Cretaceous until the beginning of the Tertiary, the authors have placed in evidence characteristic associations of pelagic foraminifera. Whether in Aquitaine, Morocco, Algeria, Tunisia, Lebanon, or Syria, the end of the Cretaceous is marked by the disappearance of the genera *Globotruncana* and *Rugoglobigerina*. Certain authors recognize the progressive passage to a zone of *Globigerina* with a mixed affinity (Tertiary–Cretaceous). The sudden appearance of the *Globorotalia* (*Truncorotalia*) marks the beginning of the Tertiary. Certain particular biofacies are described in North Africa (Morocco–Algeria–Tunisia). The authors underline the parallelism of the faunizones with the equivalent formation of Trinidad. Their considerable geographic extension gives value to their stratigraphic importance.

(Author's abstract.)

794. Application of electrical methods to oil prospecting. L. Migaux and C. Kunetz. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 545–74.—This paper aims at making more widely known the frequently ignored possibilities of applying electric methods to oil prospecting. After briefly recalling the peculiar characteristics which distinguish these methods from the traditional ones, such as gravimetric and seismic, the

paper furnishes a series of practical examples taken from prospecting carried out under varying conditions, and compared with the results of borings and other methods. It is shown that electric methods may be considered a fully efficient instrument which has already been of outstanding service in oil prospecting and deserves to be adopted on a far wider scale. (Authors' abstract.)

795. Application of moments to vertical variability maps of stratigraphic units. W. C. Krumbein and W. G. Libby. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (2), 197–211.—Conventional facies maps are designed to show areal variations in aspect of a stratigraphic unit. Experience has demonstrated that no single number or symbol expresses the whole aspect of a stratigraphic section.

The purpose of this paper is to review some of the techniques used in vertical variability maps, and to apply a method based on computed moments that expresses vertical variability of selected rock units or characteristics of the stratigraphic section as a continuous function that may be contoured. Some of the theory underlying the method is given in an appendix to this paper. E. N. T.

796. Surface alteration utilized in structural mapping—a function of earth temperature. B. H. Lasky. *World Oil*, 1956, **143** (6), 123.—Early studies of the relationship between subsurface structure and near surface temp are reviewed, and it is claimed that high temp have been associated with the crests of anticlines and domes and that temp have been found to be progressively lower on the flanks of the structures. Data on this relationship were given in API Production Bull. No. 205 (1930), and some examples from this are given. There has been little published information on earth temp for many years, and it is suggested that the significance of geothermal studies in relation to structural interpretation has been missed, partly because the geologist has not had the opportunity to use earth temp as an operating tool.

Temp investigations have been made in Oklahoma, Texas, California, and Kansas, and examples of a correlation between earth temp and subsurface structure are given with diagrams for the Big Lake field, Texas, the Humble salt dome, Texas, and the El Dorado field, Kansas. 2 refs. C. A. F.

797. Earth temperatures, alteration studies reflect subsurface structure. Pt 2. B. H. Lasky. *World Oil*, 1956, **143** (7), 116.—It has been stated that temp variations are associated with salt domes, sand lenses, faults, and structures with large and small closures, and that there are a number of sources for these variations, but it is concluded that because the temp differentials are relatively small, averaging approx 7% of present mean surface temp, geothermal prospecting is not suitable for accurate structural mapping.

Recent studies of mineralization in surface beds have shown that there has been alteration after deposition and that this can be used to map subsurface structure. A case history of this technique is described, and it is concluded that the alteration is due to the cumulative effects of geothermal variations at the surface over geological time. Maps show the interpretation of the structure of the Ramsey field, Oklahoma, based on blind alteration study compared with the subsurface structure determined by drilling. 5 refs.

C. A. F.

798. Uranium exploration methods offer advantages in petroleum finding. J. Kratchman. *World Oil*, 1957, **144** (1), 111.—Uranium has been found in many types of sedimentary rock, the quantity within the host rock being dependent on the concn of uranium in the migratory soln, the velocity of the soln, the nature of the aquifer and trap, and chemical conditions, *i.e.* the conditions for deposition are similar to those for oil accumulations, and it is suggested that exploration methods and knowledge required in oil exploration may be used in uranium reconnaissance. 9 refs. C. A. F.

799. Important fractured reservoirs in the United States. M. K. Hubbert and D. G. Willis. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 57–81.—The cumulative oil production of the U.S.A. up to the end of 1952 was 45·5 billion ($45{\cdot}5 \times 10^9$) brl. Of this, an excess of 0·7 billion brl or 1·5% was obtained from fractured reservoirs; the ultimate production from these reservoirs will probably exceed 2·5 billion brl. The most important fractured reservoirs in the U.S.A. are: the Miocene Monterey shale and chert from which the fields in the Santa Maria Valley in California produce; Jurassic basement schists from which the Edison, Wilmington, and several other California fields produce in part; the Wasatch and Green River shales in the Uinta basin of Utah from which the Roosevelt and Duchesne fields produce; the Upper Cretaceous Pierre shale, which is the reservoir rock for the Florence and Cañon City fields in the Denver basin; the Mississippian and Ordovician limestones and dolomites from which most of the Williston basin fields produce; the Permian Spraberry siltstones from which oil is produced over a large area in the Midland basin of W. Texas; the Ordovician Ellenburger limestone and dolomite from which prolific production is obtained in W. and N.-central Texas; the Upper Cretaceous chalks which are productive in SE.-central Texas, NW. Louisiana, and W. Alabama; a group of serpentine masses derived from buried Upper Cretaceous volcanoes in SE.-central Texas; and the Devonian Ohio bituminous shale from which large quantities of gas are produced in the Big Sandy and associated fields in E. Kentucky and neighbouring areas. (Authors' abstract.)

800. New geological studies result in discoveries of large gas and oil reserves from salt dome structures in the Texas–Louisiana Gulf Coast. M. T. Halbouty and G. C. Hardin, Jr. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 83–101.—Although beds of Tertiary age in the Gulf Coast of Texas and Louisiana constitute one of the most prolific oil-producing provinces in the world, there is an absence of large tectonic movements and little regional folding, and therefore the area does not have major structural features of great relief which characterize many other oil-producing provinces in the world. The Gulf Coast was, and still is, an area of low relief, both inside and beyond the coast line, with deposits through the Tertiary made up principally of continental beds and of sediments deposited in shallow marine waters, with a series of regressions and transgressions, with the net effect of moving the shore line towards the S. During these oscillations there occurred erosional periods and consequent minor, but effective, truncation of beds and traps for accumulation of oil and gas. Despite the absence of structures of great relief, accumulations of hydrocarbons are present in the Gulf Coast in less intense features, such as small anticlines, faults, faulted anticlines, sand lenses, stratigraphic traps of all types, reefs, and a combination of these structural and stratigraphic forms. The general progressive and thick deposition during the Tertiary in this large Gulf Coast homocline, amounting to a total of 50,000 ft, has resulted in certain structural features, among which the most outstanding are the piercement-type salt domes. The motive force of the uplift of these domes has been the static weight of the thick Tertiary sediments, so that the great vertical growth of the domes has taken place during the Tertiary. Because of the uplift of the domes through thousands of ft of strata, the conditions for oil accumulation around them are excellent. It was the discovery of production from the cap rock of a piercement-type salt dome that initiated the oil industry in the Gulf Coast area. New thinking in subsurface geological studies of these salt domes has resulted in the discovery of many millions of brl of oil and trillions of cu. ft. of gas. These studies have

become most important, and this paper reveals the approach to such studies and the results that can be obtained by exploring behind them. (Authors' abstract.)

801. Sand facies of recent Mississippi Delta deposits. H. N. Fisk. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 377–98.—Major sand bodies in the Recent deltaic deposits of the Mississippi River include widespread delta-front sheet sands, delta-margin island and bar deposits, bar fingers, channel fillings, and abandoned beaches or cheniers. Each of these sand units compacted underlying silts and clays during deposition and settled into them, developing a thickness far greater than the depth of water in its depositional environment. Patterns of distribution and thickness trends of the various sand bodies were established by the direction of delta growth and bear no consistent relationship to the structure of the gulf basin. Bar fingers and channel fillings extend basinward at various angles to the regional strike, and chenier deposits parallel it. Deltaic sand facies do not rest upon significant erosional unconformities as do deposits of transgressive seas, such as barrier island sands. They grade laterally and vertically into surrounding facies and pinch out basinward within a seaward-thickening wedge of silty clays. Similar sand bodies in older rocks form petroleum reservoirs, and facies relationships in the Mississippi Delta complexes provide guides for interpreting the environmental conditions under which such sand deposits developed and for predicting their trends. (Author's abstract.)

802. Petrogenesis of Permian Delaware Mountain sandstone, Texas and New Mexico. J. P. D. Hull, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (2), 278–307.—The Permian basin of Texas and New Mexico is an autogeosyncline, a surface which subsided without complementary highlands. It differs from some other autogeosynclines (Michigan basin of Silurian age, Williston basin of Mississippian age) in having had a sharply separated area of deep water, the Delaware basin, in which terrigenous sand was deposited.

The Delaware Mountain group is 3000 ft of a deep-water, terrigenous facies, almost encircled by contemporaneous reef limestone. Abundant detrital feldspar in basin rocks and in corresponding fine sand grains on the shelves at the N. and NE. suggests back-reef sources of this basin sand. E. N. T.

803. Reinterpretation of section of Cretaceous rocks in Alamosa Creek Valley area, Catron and Socorro Counties, New Mexico. M. A. Colligan and J. Q. Tomkins. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (2), 181–96.—A summary of the available information regarding the Cretaceous rocks in the Alamosa Creek Valley area, Socorro and Catron Counties, New Mexico, is desirable in order to explain the mapping of this area that is to be shown in the forthcoming preliminary geologic map of New Mexico and to clarify the relations of the stratigraphy of the Alamosa Greek Valley area to that of the S. part of the San Juan basin. E. N. T.

804. Subsurface study of Morrow and Atoka series in part of Arkansas Valley of Western Arkansas. W. W. Ballard. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (2), 263–77.—The area under consideration includes approx 6300 sq. miles in W. Arkansas and 900 sq. miles in E. Oklahoma. It is located generally between the Boston Mountains on the N., and the Ouachita Mountains on the S.

The Morrow series of the Arkansas Valley is primarily a sand and shale section in the S. and SE. parts of the area, changing to a limestone and shale section on the foreland at the NW. Wells drilled in the area have penetrated thicknesses of Morrow ranging from 250 ft to more than 1200 ft. The sandstones of the Hale formation produce gas in several fields and have considerable promise for future production. These beds are also possible oil reservoirs.

Many of the structures in the Arkansas Valley are untested. The anticlines in the central and N. parts of the area are more favourable for oil and gas production, as they are less tightly folded than those of the S. part. The Cecil anticline is a completely faulted structure, with faulting and sedimentation apparently occurring concurrently. E. N. T.

805. Geology of Deadman Butte area, Natrona County, Wyoming. T. C. Woodward. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (2), 212–62.—Detailed mapping of the S. part of the Bighorn Mountains has long been needed to complete the geologic picture of the region. The strata that underlie both the Powder River and Wind River basins are well exposed in the Deadman Butte area. A study of the rocks permits a better understanding of the stratigraphy and structure of both of these important oil-producing provinces. E. N. T.

806. Cambrian rocks of Southern Snake Range, Nevada. H. Drewes and A. R. Palmer. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (1), 104–20.—The S. Snake Range of Nevada lies between the Cambrian sections at Pioche and Eureka, Nevada, and Gold Hill and the House Range, Utah. The Cambrian rocks of this area include *ca* 5000 ft of beds assigned to the Prospect Mountain quartzite, Pioche shale, and a number of new formations which are described in the paper. Several hundred ft of uppermost Cambrian rock are left unassigned. E. N. T.

807. Reconnaissance of subsurface Precambrian of Alberta. R. A. Burwash. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (1), 70–103.—It has been shown by recent deep drilling that the Interior Plains of W. Canada are underlain by rocks similar to those of the Canadian Shield. The petrographic examination of a number of samples from wells in Central and N. Alberta has been made in an attempt to define the major Precambrian structural units of the area. It is pointed out that the major Precambrian structural units are significant in relation to studies of Palæozoic sedimentation on the Alberta shelf. The low landmass that existed in W. Alberta during Palæozoic time is believed to be due to the isostatic uplift of the eroded roots of the Peace River mountain belt. The concept of a younger Precambrian arcuate structure in W. Alberta lends further support to the theory of continental growth by marginal accretion. E. N. T.

808. Some oil-geological characteristics of Venezuela. J. Dufour. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 19–35.—A regional study, particularly of Late Mesozoic facies development in Venezuela and the NE. corner of Colombia, is of material assistance in outlining the continental framework bordering the Guiana Shield in the general Caribbean area. An analysis of this framework leads to the conclusion that in Late Mesozoic time the epi-continental shelf extended in NW. Venezuela and NE. Colombia, compared with central and E. Venezuela, considerably farther out from the Guiana Shield. It is suggested that this extension of the epi-continental shelf is bordered in the NE. by a deep-seated disturbance in the nature of a geofracture. This postulated disturbance would roughly run from the N. Goajira Peninsula in a SE. direction, approximately via Barquisimeto, towards the Guiana Shield. It would appear to have influenced the primary configuration of sedimentation conditions in part of the Late Mesozoic orthogeosyncline, and its recognition is of great economic importance, since it separates 2 wide areas of contrasting production potential. The outer part of the shelf is most significant in that it represents the principal area which during Cretaceous times provided conditions favourable for the formation of oil source rock. In NW. Venezuela and NE. Colombia this part of the shelf area is characterized, during Cretaceous times, by the presence of troughs and highs. Mainly post-Cretaceous tectonics are responsible in this area

for the forming of a mosaic of major blocks (containing the aforementioned troughs and highs) which are distinct from one another in respect of orogenic deformation and removal of Cretaceous rocks by erosion in a varying degree. Particularly favourable conditions with regard to the preservation of Cretaceous oil source rock are noticed in the Maracaibo Block; this block is further characterized by its outstanding tectonic rigidity. Some aspects of regional migration of Cretaceous oil are discussed and the general regularity in the geographical distribution of the oil, worked out on the basis of its specific gravity, is illustrated both in the Llanos basin and in that of Maracaibo. (Author's abstract.)

809. Introduction to the geologic map of the Republic of Venezuela: scale 1:2,000,000. A. S. Anglade. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 103–8.—This paper explains the outstanding features of Venezuelan geology as shown in the map. 8 geologic and physiographic provinces are described as follows: (1) Guayana Highlands: the Guayana Shield, which includes the oldest crystalline rocks in Venezuela; (2) the Llanos: the flat, central region, formed by Tertiary and Quaternary sediments, with some metamorphic and igneous rocks at El Baul; (3) Orinoco Delta region: swampy deltaic plains of recent age; (4) Maracaibo basin: a structural and topographic depression bordered by the Perija and Andes Mountains, with sediments from Palæozoic to Quaternary; (5) Falcon region: E.–W.-trending mountain ranges formed by Tertiary and Quaternary rocks with some igneous masses, especially in the Paraguana Peninsula; (6) Venezuelan Andes: E. prolongation of the S. American Andes with rocks from Palæozoic or older, to Quaternary; many large, acid igneous masses; (7) Coast Range: the mountain system along Caribbean Sea coast; principally metamorphosed and unmetamorphosed Cretaceous sediments, with some acid and basic igneous masses, and Tertiary and Quaternary rocks in isolated basins and along the S. foothills; (8) Island of the Caribbean Sea: island constituted by Cretaceous to Quaternary rocks, with many basic and acid igneous rocks. (Author's abstract.)

810. Geologic history of Santa Ana structure, Anaco structural trend, Anzoategui, Venezuela. L. M. Banks and E. S. Driver. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (2), 308–25.—The structure of the Santa Ana oilfield in central Anzoategui comprises a subsurface thrust fault (Anaco thrust), with approx strike No. 65° E. and NW. dip of *ca* 45°, and 3 elongated oil-bearing domes oriented along the fault in its NW. segment. The field is part of the Anaco structural trend, which, with the same characteristics, continues NE. for more than 40 km to determine the San Joaquin, Guario, and Santa Rosa oilfields. Repeated sections measured in Santa Ana wells, ascribed to the Anaco thrust, vary from 80 to almost 1500 ft, but stratigraphic throws are still larger in San Joaquin. In Santa Rosa, where no wells have yet penetrated the thrust, dislacements may be of the order of 3000 ft or more. The thrust fault is best known in the Santa Ana area, where ample subsurface control is available; it appears to die out upward at the Officina–Freites contact. E. N. T.

811. Reasons for Persian Gulf oil abundance. J. Law. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (1), 51–69.—The author concludes that the remarkable volume of the oil reserves in the Persian Gulf area is due, not to any single factor, but to the coincidence of all the conditions favourable to the generation, entrapment, and preservation of hydrocarbons. These conditions include a very large volume of marine sediments, many of them favourable to oil generation; structural and stratigraphic traps which were present during primary oil migration; numerous large anticlines; excellent reservoir and cap rocks; and lack of important unconformities. It is suggested that variations in the oil gravity, which to date have been perplexing, may be in fact due to varying amounts of terrigenous source material. E. N. T.

812. New aspects of the geology in Central Iran. A. Gansser. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 279–300.—Sediments have been recorded in the Central Iranian basin which range from Cambrian to Recent. They have undergone 5 major and 7 minor orogenetic cycles, of which the Late Jurassic–Pre-Middle Cretaceous diastrophism was particularly intense. A Central basin began to form with the Upper Cretaceous and was, after an Eocene marine period with intense volcanism, well outlined during the Oligo-Miocene, and filled with shallow marine deposits. They form the only prospective oil formations and resemble somewhat the Asmari facies S. of the Zagros range. Local sea connexions between N. and S. must have existed. The cap rock evaporites have produced *ca* 50 salt domes in Central Iran, which pierced as much as 5000 m of Mio-Pliocene brackish to terrestrial deposits, reminiscent of an environment reflected by the present alluvial salt deserts. (Author's abstract.)

813. The Oligo-Miocene Marine formation in the Qum region (Central Iran). M. A. Furrer and P. A. Soder. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 267–77.—The search for oil in Central Iran led to detailed stratigraphical and palæontological examinations of the Oligo-Miocene Marine formation in the Qum region. This formation can be subdivided into lithological units, some of which laterally change over relatively short distances. Based on larger and smaller foraminifera, which abundantly occur, correlation of the particular units exposed at the surface as well as encountered in boreholes is possible. In a brief discussion the Oligo-Miocene Marine formation is compared with the Asmari Limestone in SW. Iran. In spite of great lithological differences, a remarkable conformity with regard to the larger foraminifera exists. (Authors' abstract.)

814. Palæozoic prospecting in the North Hoggar (Sahara). A. Guillemot, P. Michel, and D. Trumpy. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 243–9.—It was not until 1949 that certain geologists began to think that the already well-known sedimentary deposits of the Sahara could be of interest to the petroleum world. In spite of the lack of manifest activity and the distance from human habitations, prospecting was undertaken on a grand scale. In Feb 1952 the Regie Autonome des Pétroles lodged a request for permission to prospect on the N. fringe of Hoggar and had a complete series of aerial photographs made immediately by the National Geological Institute. The geological study from photographs, undertaken by the French Institute of Petroleum and Shell, gave good results and enabled the first bore to be established in a spot 120 km SE. of In-Salah, called Berga. The drilling, begun on 21 Dec 1952, arrived at the discovery of a gas field in March 1953, 2 years after the request for permission. The authors describe the main stratigraphic and tectonic features of the field, especially simple within the perimeter of the Compagnie de Recherche et d'Exploitation de Pétrole au Sahara. The first results obtained are encouraging. However, it is still too early to say anything definite of the petroleum prospects of the N. fringe of Hoggar, in particular, and of the Sahara in general. (Authors' abstract.)

815. The search for oil in French Equatorial Africa. V. Hourcq. *Proc. Fourth World Petrol Congr.*, 1955, **1**, 215–42.—After presenting the general features of the main stratigraphical and structural African units, the author details the geological conditions resulting from the work achieved in the French basins of the West Coast, and particularly the Cameroons and Gabon basins (French Equatorial Africa). Information about the problems involved in oil prospecting and the results obtained are given. Moving to E. Africa, the

author gives the same kind of account regarding Madagascar. In conclusion, after a summarized review of the sedimentary and structural conditions of the African basins and the main characteristics of their palæogeography, the author discloses his optimistic feelings concerning the final result, in spite of the special problems involved. (Author's abstract.)

816. Oil in Afrique Noire, 1957; departure of first tankers from Gabon. R. Buttin. *Bull. Ass. franç. Tech. Pétrole*, Jan 1957, 27–44.—In the current year it is hoped to ship over 200,000 tonnes of crude from Gabon. Investigations in Gabon began in 1928. Principally geological studies were made until 1945, after which there was more intensive drilling and geophysical work. The area is almost entirely forest-covered, with little in the way of access beyond the main rivers, and the climate is trying. In 10 years geologists examined 20,000 km of streams. Attention was then concentrated on the interior basin and the cliff problem of the Lambarene area, leading to the discovery of some good oil indications and the producing well OU 5. In 1954 the coastal area was tackled, and showed the presence of a thick Tertiary sequence, favourable structures associated with salt domes, and that geophysical methods were applicable. Seismic reflection techniques gave good results in low areas, but not on high ground, where there is *ca* 250 m of the sandy Cirque series, and in such areas the anomalies may be spurious from a structural angle. Late in 1955 PG 5 drilled on a salt dome near Port Gentil had some good shows and a production of 4–5 m^3/day. Early in 1956 OZ 1 on the Ozouri salt dome found oil production. This flat-topped dome is *ca* 20 km^2 in area and is *ca* 1000 m deep. Overlying the clay–dolomite non-permeable cap rock is a clayey silicified series with numerous dolomitic beds, the fractured silicified zones constituting the reservoir rocks. The Oligocene does not occur everywhere over the Eocene, and Miocene and younger beds overlie these. Faults create 4 sectors, in 2 of which oil has been found.

The Pointe–Clairette salt structure, unlike the others, is non-piercing, and on this NA 1 found oil in sands of Senonian age. Palæocene, Eocene, and Miocene beds follow, while Albian silty clays immediately overlie the salt, which is *ca* 2000 m deep.

Pipeline and other facilities are under construction, the number of rigs is increasing, and before long an output of 1000 m^3/day is expected. Expenditure in 1954–55 was *ca* 2 milliards of francs, 6 milliards in 1956, and will be 8–10 milliards in 1957. The oil activities will bring a variety of benefits to Gabon and its people. G. D. H.

817. Contribution to geology of the Cuanza basin, Angola. C. Brognon and C. Venier. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 251–65.—The geological structure of the Cuanza sedimentary basin (Angola, Portuguese W. Africa) is described. The report is mostly based on up-to-date results from explorative operations of this region started by Petrofina since 1952. Collected data about stratigraphy and tectonics are reported by the authors, while the various sedimentary conditions of the basin are described and its geological evolution through tertiary and secondary age reconstructed. Oil possibilities are finally discussed, on the base of existent reservoir rocks and tectonic accidents.

(Authors' abstract.)

818. The petroleum possibilities of the European Jurassic. E. Bonnard *et al. Proc. Fourth World Petrol Congr.*, 1955, **1**, 173–95.—The problem of the Jurassic is first considered in its entirety in the whole of Central Europe, where surface indications and production are known in various horizons. The extent of the sedimentary horizons (source rocks and reservoir rocks) appears to be controlled by the effect of topographic highs and submerged areas in the ancient Hercynian chains. That which essentially differentiates the N. basins in Germany and England from the French basins is the greater development of sands in the first, and the abundance of limestones and dolomites in the second. The petroleum possibilities of the Jurassic in the principal French basins is as yet little known, and each one is above all examined from the point of view of its reservoirs, source rocks, and surface indications, which are known at the moment. An attempt has been made to esteem the possible value of each of these horizons, and their structural value is often evoked only to show the way for possible future study, particularly in the line of geophysics. The following basins are considered with the above attitude: the Paris basin, the Aquitaine basin, the S. Prealpine basin, and the Rhone Corridor, which includes the Languedoc, the N. Prealpine basin, which includes the Jura and the Bresse, as well as the Plain of Alsace. In the actual state of our knowledge, the most interesting objectives appear in the lower Lias, the Dogger, rich in surface indications with a small production at Staffelfelden in the Haute Alsace, the upper Jurassic, which contains reef structures, and particularly the terminal Jurassic, which, with a dolomitic facies, is producing in Aquitaine. (Authors' abstract.)

819. Oil accumulation and the Jurassic system in North-west Germany. K. Hoffmann and W. Schott. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 161–71.—For a number of years the German crude oil industry in NW. Germany has been aiming at finding oil accumulations from Jurassic sediments. Important connexions between the distribution of these oil-fields and both the extension and facies of the NW. German Jurassic basin have been established. Thus oilfields with oil from the Jurassic are mostly encountered in areas of strong subsidence and sedimentation within the Jurassic basin. To identify and form an opinion on these connexions it proved necessary to investigate the expansion of the basin and its sedimentary thickness during the different Jurassic times. The Jurassic reservoir rocks have been described separately.

(Authors' abstract.)

820. Reflection-seismic exploration of Schleswig-Holstein, Germany, and its geological interpretation by well data. F. Hecht, H. von Helms, and W. Kehrer. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 716–30.—Detailed reflection-seismic surveys have been carried out all over Schleswig-Holstein. They have resulted in an accurate delineation of geological structures, because the exact stratigraphical position of typical seismic horizons was obtained from well data, and because, on a regional scale, certain horizons could be traced by means of uniform velocity-parameters. The geophysical investigation was considerably intensified when exploration wells found excellent oil reservoirs in the Wealden and Dogger. Thus, the geophysical problems changed from those associated with salt domes to those arising in the search for structural and stratigraphical traps within the Dogger. The geophysical results, combined with those of more than 40 deep wells, have furnished detailed stratigraphical, lithological, and structural data on the most dominant structures, the flanks of salt domes and sedimentary basins. As a result, the main structural units of Schleswig-Holstein have been disclosed as: (1) the West Schleswig block; (2) the East Holstein block, both being smooth uplifts with structurally high-lying Trias; and (3) the Middle Holstein block, which is divided into the 2 deep-rooted Jurassic troughs of Heide and Bramstedt-Kiel with marked subsidence and sedimentation during the Jurassic, and the Rendsburg uplift, which lies between them and is characterized by high-lying Trias and by shallow depressions between salt-diapirs which have a Rhenish trend. The palæogeographical and structural genesis of these Jurassic troughs is discussed in detail. Typical Saxonian tension tectonics are confined to the Middle

Holstein block, the W. and E. boundaries being characterized by strong fault zones. A distinctive swing from S.–N. to SE.–NW. in the NE. part of the Middle Holstein block probably indicates a break in Stille's "Mittelmeer-Mjosen-Zone," caused by proximity to the "Tempelburger Achse." The Rhenish zone reappears again farther N. in the Zechstein salt dome basin of NW. Jutland. The newly discovered oilfields of Schleswig-Holstein produce exclusively from the "Wealden" (Hohenworden) and the Dogger (Hohenworden, Plon, Boostedt, Bramstedt). They are confined, together with the long-known deposits on the Heide salt diapir, to the Jurassic troughs and the Tertiary depression zones. The conclusion is justified that the development of the oil deposits depends on the structural configuration of the area. The Lias with its sapropelitic sediments is believed to be the source rock, from which the oil was moved as a result of the enormous subsidence in the Tertiary depressions.

(Authors' abstract.)

821. The Wealden formation in the Netherlands. G. C. L. Sung. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 151–60.—Beds of 2 entirely different facies types in the Netherlands are considered as being of the same age as the Wealden formation of SE. England. First, typical lacustrine sediments occurring in the NE. Netherlands, which lithologically and palæontologically (based mainly on the ostracod-fauna) can be correlated with the German "Wealden" of the NW. German basin, as well as with the beds outcropping in the type locality of the Wealden in SE. England. Secondly, fluviatile–deltaic deposits occurring in SW. Netherlands, which must be attributed, at least in part, to the Wealden formation, deduced from their stratigraphic position. No diagnostic macro- or micro-fauna has been found in these deltaic beds, so that there is as yet no definite palæontological evidence for the assumption that these beds are equivalent in age to the Wealden formation of SE. England. Lithologically the beds resemble the ferruginous deposits of Shotover Hill (Oxford) and the "Fuhse layers" in boring Thoren 1 (nr Hanover). The presumed extent of the lacustrine sediments in the NE. Netherlands and the probable extent of the fluviatile–deltaic deposits in the SW. Netherlands, based on borehole data, are given on a palæogeographic sketch-map. The position and direction is also given of the "Netherlands Ridge," which influenced the sedimentation pattern in the Netherlands from late Palæozoic to Cretaceous times. (Author's abstract.)

822. Underwater gravity survey in the Adriatic Sea. C. Morelli. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 661–3.—Reference is made to a first-order survey (1953 and 1954) carried out in the N. Adriatic Sea down to the parallel through Ancona. For the determination of position on the high seas, there was an immediate improvement by the use of radar, which, in the triangulation from the Italian to the Yugoslav coast, made possible a compensation for the errors of close. The gravity anomalies indicate some interesting tectonic features (basement of Istria, axis of the Po plain syncline, etc.). Above all, they reveal the existence, in the coastal area, of a series of interesting phenomena, which serve both as a confirmation of geological intuitions and as a starting point for new possibilities in the search for hydrocarbons.

(Author's abstract.)

823. The Cretaceous–Eocene boundary in Italy. M. B. Cita. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 427–52.—Italian Upper Cretaceous is represented by 3 lithological facies: a deep sea facies, often calcareous, containing pelagic foraminifera; a flysch facies much thicker than the preceding one, characterized by clastic sedimentation; and a shallow-water facies with organic limestones ("urgonian facies"), containing rich faunas with rudistæ and large foraminifera. Geographical distribution of cited facies in Italy is indicated. The passage from Upper Cretaceous to Eocene occurs with continuous sedimentation, as a rule, in localities where deep-sea facies are developed in Upper Cretaceous sediments, while disconformities are often observed in outcropping areas of reef-limestones. In order to illustrate the discussed question of the Cretaceous–Eocene boundary, the author studied from a micropalæontological point of view several stratigraphic sections from outcrops where a continuous sedimentation could be supposed. Environmental conditions being constant in Cretaceous and Eocene layers, the one cause which affects faunal changes is evolution as a function of time. Presence of Danian and Palæocene stages above Mæstrichtian is pointed out. (Author's abstract.)

824. The results of petroleum research studies in Sicily. (In French.) E. Benes. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 109–24.—Sicily derives its geological structure from the way in which rigid masses (generally limestone rocks) and plastic masses (generally clay rocks) come to rest with respect to each other when subjected to upward stress and the force of gravity. Recent geological surveys, geophysical explorations, and data obtained from wells drilled as recently as 1953–54 have shown that this structure consists of interbedded series of clay strata and sedimentary layers from normal Tertiary deposits; the whole system overlies a rigid substratum which outcrops here and there in different parts of Sicily, as Secondary and Tertiary rocks (the Ragusa plateau, bedded or non-bedded limestone layers in the Sicani Mountains, at Palermo, Trapani, and the Madonie), or as Primary rocks (metamorphic rocks of the Peloritani Mountains). The plastic-flow series (which frequently contains "exotic" masses of periods ranging from the Miocene to the Carboniferous) are particularly characteristic of Central and S. Sicily, where they fill a very deep trough, whereas to the E. and N. normal deposit sediments are prevalent. Recent drilling (Ragusa) has revealed the possibility of a pay area in a deep-seated part of the substratum (calcareous-dolomitic clastic rocks). The porous calcareous roof of the substratum, providing it is accessible through its top shield, offers a good mineral potential. Finally, if porous materials are present in sedimentary layers interbedded with clay strata, there is every probability of their representing oilfields.

(Author's abstract.)

825. The possibilities of using seismic investigations in the Magura plateau. A. Kislow. *Nafta (Krakow)*, 1955, **11**, 226–9.—The Carpathians contain many plateaux, each built up from several small sharp undulations overlapping "scale" fashion, and this causes many difficulties for the geologists. One such plateau is Magura and seismic investigations there were started in 1952 using Soviet equipment. Charges were placed approx 750 to 1250 m apart at depth 16–19 m, always below water table. Results are satisfactory in spite of the difficulties. 2 profiles, SW.–NE. and one NW.–SE., have been given as illustrations of the difficulties encountered. Considerable progress has been made in elucidating the structure of this and Silesian plateaux. On the whole the equipment is somewhat too heavy for more detailed shooting of this mountainous terrain. M. S.

826. Research works in the Filovci structure area. L. Berdon. *Nafta (Yugoslavia)*, 1956, **7** (11), 344–8.—The general situation of the new Filovci field, near Lendava, after investigations. (Author's abstract.)

827. The oil possibilities in Greece. G. A. Aronis. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 125–49.—The earliest oil research in Greece dates back to 1848. At first, no system was followed, but later systematic scientific data were adopted as a basis. Detailed geological knowledge of the interesting potential areas in Greece is not yet complete. Until the last world war only a few test wells were drilled, mainly in 2 areas

of the country, Zakynthos, W. Peloponnessus, and in W. Thrace. In these areas surface studies were recently repeated and wells were or are to be drilled. This paper deals with the stratigraphy, structure and palæogeography, and oil potential in Greece, as deduced from the existing bibliography, reports, research, and personal observations of the author.
(Author's abstract.)

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

828. Geophysical prospecting over continental shelves. H. C. Cortes and R. N. Gsell. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 575–603.—Geophysical methods were initiated and successfully used on land, and later in marshes and inland waters. After prolific oilfields were found in California, Louisiana, and Texas near ocean waters, it became a question of time as to when open-water prospecting would be done. Many difficult problems were encountered and solved in extending the search offshore. New and different equipment became a necessity. The principal methods used, in order of increasing resolution and operating costs, have been magnetic, gravimetric, and seismic. Major amounts of offshore geophysics have been done off California, Louisiana, and Texas. Comparatively small areas have been covered offshore with the airborne magnetometer. The remote-controlled gravity meter, or gravimeter, has been employed in a number of areas. The reflection seismograph is the most widely used method. Early surveying was done by wire line and transit. These have been replaced by radar, continuous radio wave, and sonar methods. Since the greatest volume of marine geophysical work has been conducted in the Gulf of Mexico off Louisiana and Texas, the largest number of offshore oil and gas discoveries has been in these areas. To July 1954 there have been 37 discoveries off the coast of Louisiana and 2 off the coast of Texas. Seismic work on large open-water areas can be done as cheaply, or more cheaply, per linear mile than on land. The economic climate created and maintained by governments will be a major factor in the future geophysical prospecting and development of the Continental Shelves. (Authors' abstract.)

829. New developments in seismic methods. H. Salvatori. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 605–18.—The past few years have seen extensions and refinements of older seismograph techniques. Although no fundamental changes have taken place, methods and devices have been improved and expanded to enlarge the sphere of activity of the reflection method. Pattern shooting as an accepted field technique has made possible the exploration of previously unworkable areas. Individual trace analysis has proven valuable for special problems. Seismic amplifiers now provide automatic volume controls with several rates of response that may be readily adjusted to meet the particular requirements of specific areas. Replayable recording on magnetic tape offers a new degree of versatility in instrumentation. Field equipment has seen several important improvements and new devices. Among these are the air and auger drills, specialized tracked vehicles, and a cable-handling device. Continuous control of velocities and move-outs of individual reflections removes an important source of interpretation errors. Research and development is proceeding apace from investigation of basic earth physics and information theory to new and improved instruments and techniques. (Author's abstract.)

830. Exploration for reefs by geophysical methods. F. J. Agnich. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 619–34.—Methods used in geophysical exploration for limestone reefs are described. Limestone reefs are defined and their structural characteristics given. Close co-ordination of all geological and geophysical data is extremely important throughout an exploration programme. Where reefs are shallow and the density contrast with surrounding materials is relatively great, the gravity meter can be successfully employed. The seismic refraction method, like the gravity method, is strictly limited to shallow reefs. Even then a favourable contrast in velocity must exist between the reef and the geologic section around and above it. The most effective geophysical method in reef location has been the reflection seismograph. Data must be interpreted in the light of effects caused by reefs. Compactional folding above a reef is a prime criterion for identification by reflections. Other seismic evidences of reefs are described, and a successful programme specifically designed to locate a reef is discussed briefly.
(Author's abstract.)

831. Modern methods of gravity and magnetic interpretation. S. I. Hammer. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 635–46.—Recent developments in gravity and magnetic interpretation techniques in exploration for petroleum reveal a definite trend towards more quantitative evaluation and utilization of data. This is a logical consequence of: (1) improved instrumentations which yield higher-quality surveys, and (2) the need for reconnaissance surveys to guide and localize more costly phases of exploration such as seismic work, leasing, and test drilling. Modern interpretation techniques in use and under development are reviewed and illustrated by selected maps and figures. These include "residual" and "second derivative" maps, "resolution," "continuation," "statistics," and "electronic computations." Underground observations to yield a third dimension in exploration are included. Important work on geophysical rock properties is considered. Economies in the overall exploratory effort which may result from intelligent use of gravity and magnetic surveys are mentioned.
(Author's abstract.)

832. Geophysical technique employed for petroleum exploration in Mexico during the last 15 years. S. F. Huerta. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 647–60.—In 1940 the petroleum provinces of Mexico were in widely differing stages of exploration and exploitation. For their further development a programme of exploration has been carried out in which geophysical methods have played an important role. By applying practically all the available geophysical methods it has been possible to study a large part of the oil-bearing subsurface where conditions are extremely varied. In some cases special techniques have been employed in the investigation of reefs, high relief structures, salt domes, and fracture zones. As a result of the new exploration campaign there has been a steady advance in the accumulation of information.
(Author's abstract.)

833. Correlation of geological and geophysical data. D. C. Skeels. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 665–73.—The importance is stressed of careful co-ordination of geological and geophysical data in both regional and local exploration. The application of geological information in guiding geophysical interpretations, and the use of seismic records in subsurface mapping of stratigraphic units is discussed and is illustrated by examples from several areas.
(Author's abstract.)

834. Magnetic tape recording gains popularity. A. D. Waldie, T. O. Moore, and H. J. Jones. *World Oil*, 1956, **143** (7), 114.—The field performance, lab characteristics, and the compilation of data by mechanical methods using magnetic recording of seismic data are discussed. Seismic signals are now available on a permanent record containing all the detail of the signals, enabling the geophysicist to obtain the best records possible whether the signal quality be poor or good.

Automatic data processing has reduced considerably the work of seismic computing by providing in many cases a direct

mechanical analogue of the conventional procedures in computing. This equipment is costly, and has so far been used only where a very large amount of data is to be analysed. 5 refs. C. A. F.

835. New techniques in marine geophysics. T. R. Goedicke and E. R. Locke. *World Oil*, 1956, **143** (7), 122.—Recent developments in equipment and techniques in offshore seismic work are briefly described. They comprise the use of floating seismic cables, new types of detectors, including magnetostrictive and pressure-sensitive detectors using a diaphragm, crystal hydrophones, and velocity geophones. Techniques include the magnetic tape recorder and special cameras recording seismic data on paper or film. Data processing based on special cameras can use the variable density system, the Reynolds system, or combinations. C. A. F.

836. Contribution to geochemistry by the study of the evolution of crude oil in sedimentary basins. F. Bienner *et al.* *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 337–57.—Some crude oils, exposed to air and sunlight, evolve gradually towards the formation of asphalts. Particular hydrocarbons are transformed into resins: they subsequently yield asphaltenes and carbenes. This evolution is accompanied by a change in its chemical nature; thus a paraffinic or mixed oil produces a naphthenic asphalt. Similar transformations have been studied in the following oilfields: (1) the crude oil migration in the Oued Beth fields has occurred without any notable alteration; (2) at Chelif, in an outcrop, malthes and asphalts proceeding from a crude oil may be found; (3) on the Bastennes diapyr, asphalts and crude oils appear; (4) at Pechelbronn, in a fractured zone, some crude oil is transformed into malthes and asphalts. (Authors' abstract.)

837. Developments in geophysical and geological exploration for oil in Germany 1951–1954. A. Bentz and H. Closs. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 691–713.—The type of geophysical and geological methods used in the 3 principal oil provinces of Germany depends on the type of geological structures. As yet the greatest success has been achieved in NW. Germany, where there are salt domes, anticlines, deep-seated domes, fault-structures, and stratigraphical traps in similar numbers as on the Texas Gulf Coast. In the Rhine Valley graben, fault structures prevail and the new reflection seismic work shows interesting structural features, also in the central parts of the graben. The Molasse trough is a highly asymmetrical basin of sedimentation with folding in the S. and faulting in the N.; stratigraphical traps in combination with faults have recently been discovered. Oil exploration in Germany is characterized by very close co-operation between geophysics and geology in every phase. (Authors' abstract.)

838. Comparative geological and geophysical study of the Po basin. T. Rocco. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 675–90.—After a reference to the development of the oil exploration which has been carried out during the last few years, general and critical information is given on the gravitational and seismic surveys made by AGIP Mineraria in the Po Valley. The results obtained with these 2 geophysical methods and with extended stratigraphic studies on a large number of wildcats are then compared in the light of the knowledge of the principal structural features of the Po basin. (Author's abstract.)

DRILLING

839. Needed—a low cost drilling method. I. S. Salnikov. *Oil Forum*, 1956, **10**, 413–14.—In 20 years well costs have risen *ca* 150%, due chiefly to deeper drilling and higher labour and equipment costs. Inability to offset increased labour and material costs by improving operating eff of rotary rigs is serious. The forecast of 13,000,000 b.d. demand in 1975 may be reached in 1965. *Per capita* demands are rising; the population is growing faster than expected. The problem is to find, drill, and produce more crude at costs higher than previously bearable. It is anticipated that production in the next 25 years must equal that of the past 98 years. Assuming that the U.S.A. has found approx ½ the total crude oil resources, industry must find and develop all its resources in the next 25 years. Statistical studies show that each exploration and development well discovers and develops less oil than its predecessor of 10 years ago. To develop reserves, from 1,600,000 to 2,000,000 wells would be required, drilled deeper at greater cost. Some producers working through Drilling Research Inc., are contributing men and money towards improving drilling methods and developing new ones. Lines of approaching the problem are suggested. R. T.

840. Effect of additions to drilling mud on spectrographic analysis. Z. Biernat. *Bull. Polish Inst. Petrol.*, 1955, **6** 11 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—Bentonitic drilling mud with added barium serves as identifying medium for certain strata found at Krosno. Due to excessive sensibility of this method, extra precautions are necessary. M. S.

841. Drilling fluids for difficult conditions. J. Gumulczynski. *Nafta* (*Krakow*), 1955, **11**, 230–3.—3 kinds of mud are described as suitable for drilling in shifting (granular) formations, limestone, and through shales with a tendency to swell respectively. Satisfactory results have been obtained with $BaCO_3$ against gypsum and anhydrite pollution. Lime in muds prevents any increase in visc when drilling through granular formations from which the mud removes fine particles. Salt and starch in mud allow drilling through almost any electrolyte, but such mud is corrosive. M. S.

842. What every driller should know about steel. J. Tyczynski. *Nafta* (*Krakow*), 1955, **11**, 289–91.—Brief résumé of properties of various steels and methods of working them, together with the temp range at which each operation is to be carried out. Table including 16 grades, their properties, composition, and applicability is added. M. S.

843. Diving instrument for measuring mud filtration of type R.O. J. Ostaszewski and S. Rzepecki. *Bull. Polish Inst. Petrol.*, 1955, **6**, 12 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—This instrument replaces baroid apparatus. Its description and operation are given in detail. Also a note on search for sulphur in the Swietokrzyz (Saint-Cross) mountains (by Z. Olewicz). M. S.

844. Turbo-drilling. Z. Onyczewski. *Nafta* (*Krakow*), 1955, **11**, 277–81.—In the U.S.S.R. the turbo-drill has become the main drilling instrument, its use rising from 31·1 to 75·8% from 1948 to 1953. A table of the various grades of turbo-drill is given. Drilling fluid has to be supplied at 35–55 l/sec. Their efficiency is of the order of 60%. 3 methods are available for increasing the efficiency, *i.e.* increase in the flow rate of mud, increase in vertical load, and increase in the number of stages. 100-stage turbines are now in common use, and 150-stage are being built. Characteristics of several types are given in tables, and results of coupling show the potentialities of still bigger turbo-drills. A great deal depends on the mud pumps which have to deliver the fluid at some 100 atm and up to 60 l/sec; the development of these has now been successfully completed. Other mechanical improvements are in clutch, feeding, and break mechanisms, which are now pneumatically powered, automatic pressure regulation, gear box, and coupling equipment for extra power. Specially hardened chain drive cuts down the breakdown time to 1% (from 5%). Drilling fluid is of low visc and carries away rock fragments due to its high annular velocity. Lately, pure water has been successfully used in 76·2% of drilling

(1953). Due to this and other changes the mean progress/unit/month was in 1953 739·3 m, as against 400·7 m in 1949. Due to lower visc of the fluid the wear of equipment is less and water is also cheaper than muds. There were no cases of seizure in 1952. Before the drill is withdrawn it is necessary to clear out all the fragments from the well, so the water is circulated for a longish while. A disadvantage of the use of pure water is increased corrosion. In loam formations there is a danger of absorption of water into the rock, and here ordinary muds are better. Analysis of drilling schedules is given in a table of results of some exploratory and search drilling. Turbo-drilling is 50–100% faster than ordinary rotary drilling, and power can be supplied at the rate of 0·3 h.p/sq. cm. At 70–75 l/sec from 3 pumps and pressure 30–35 tons, 1701 m have been drilled in 19·5 days in particularly favourable conditions in "2nd Baku." In general, drilling is faster, more surely vertical, constant dia, economical in pipes, measuring instruments, free from vibrations, and cleaner. Its disadvantages are: (1) wear on pumps; (2) inability to drill slowly even where this is to be preferred; and (3) inability to cope with those conditions where higher gravity and visc mud are necessary. M. S.

PRODUCTION

845. Effect of stratification on relative permeability. A. T. Corey and C. H. Rathjens. *J. Petrol. Tech.*, 1956, **8** (12), 69–71.—The capillary pressure–desaturation curves of sedimentary rocks can be approximated by $P_c^{-2} = CS_{oe}$, C being being a constant and S_{oe} the effective oil saturation based on the percentage pore vol effective to flow. The oil relative permeability is approximately given by $K_{ro} = S_{oe}^4$, and gas relative permeability by $K_r = (1 - S_{oe})^2(1 - S_{oe}^2)$. These relationships have been used for calculating the relative permeability–saturation curves for series and parallel arrangements of 2 homogeneous components, the proportions being varied. The critical gas saturation was zero for the parallel arrangement for the assumptions employed; for the series arrangement the critical gas saturation was 65% when the coarse component was 90%. The curves for the parallel arrangement showed an inflection corresponding to the saturation at which the fine material first begins to desaturate.

The qualitative features of the computed curves have frequently been observed in measurements on cores.

Plots of apparent effective oil saturation have been made against oil saturation. On extrapolation to 100% oil saturation the apparent effective saturation is over 100% when there is stratification perpendicular to the flow and less than 100% when the stratification is parallel to the flow.

G. D. H.

846. Breakthrough sweep efficiency of the staggered line drive. M. Prats. *J. Petrol. Tech.*, 1956 **8** (12), 67–8.—The form of the breakthrough streamline has been determined analytically, and by this means the correct values for the breakthrough sweep efficiencies have been calculated for a staggered line drive. Previously sweep efficiency calculations had been based on the supposition that the streamline of highest velocity was the line between the input and output wells. The efficiency calculated from the more correct form for the breakthrough streamline can be as much as 7% greater than for the other assumption. G. D. H.

847. Application of engineering effort through use of reservoir analysers. K. E. Montague, M. D. Noble, and F. E. Buchanan. *J. Petrol. Tech.*, 1956, **8** (12), 12–16.—The reservoir engineer is concerned with collecting, assembling, and analysing large amounts of basic information obtained in developing an oilfield in order to design the most economic oil recovery process. It is desirable to simplify and speed up his work. Because of uncertainties about some aspects of reservoirs, analogue computers have been employed and adjusted by trial and error to match the known pressure decline. Potentiometric analysers have been used to deal with displacement problems, and to find the best arrangements of injection and producing wells. These devices allow the engineer to work more quickly and to devote more time to original and creative work.

G. D. H.

848. Note on the skin effect. M. F. Hawkins. *J. Petrol. Tech.*, 1956, **8** (12), 65–6.—The pressure drop in a well bore as a result of production at a constant rate for time t, where t is sufficiently large, is

$$\Delta p_t = \frac{q\mu}{2\pi k_e h}\left[\ln\left(\frac{k_e t}{\mu c f r_w^2}+\right) + 0{\cdot}809 + 2\left(\frac{k_e}{k_a} - 1\right)\ln\frac{r_a}{r_w}\right]$$

k_e is the external permeability, k_a the altered permeability extending to radius r_a, and $\left(\frac{k_e}{k_a} - 1\right)\ln\frac{r_a}{r_w}$ is S, the skin effect. S and k_e may be obtained by pressure build-up tests, and the average permeability k_{avg} by productivity index tests. The productivity ratio is

$$P.R. = \frac{k_{avg}}{k_e} = \frac{\ln r_e/r_w}{\ln r_e/r_w + S}$$

Plots have been made of $P.R.$ against S for various tests, and of the above equation for values of r_e/r_w from 100 to 50,000. The equation applies to the steady state, while the points may not satisfy this condition. Points with negative skin effects below the curves may be due to very large drainage radii, and those above to very restricted drainage radii. Further plots of S against r_e/r_w for various values of k_e/k_a suggest that well improvements with S more negative than -6 call for the improvement to extend beyond 200 r_w.

G. D. H.

849. Significance of fluid injection in United States oilfields. P. D. Torrey. *Oil Forum*, 1956, **10**, 425–8.—A brief historical survey of progress in application of secondary methods of recovery is given. Gas injection into reservoirs of partly depleted fields in W. Virginia and SE. Ohio has been successful. Later, secondary methods have been successful in the shallow Illinois fields, in the Pennsylvanian sand producing areas of Kansas and Oklahoma, and in the fields of the SW., Rocky Mountains, and California. Primary pressure maintenance began in SW. and Pacific Coast fields, giving recovery—more rapid, in greater quantity, and at less cost—by early-life injection of gas or water into reservoirs. Effects of fluid injection on oil production in Pennsylvania, Illinois, and Texas are discussed fully. The estimated amount of oil existing originally, and the additional oil procurable by fluid injection methods in individual states are tabulated. The pattern of future oil production from water injection is shown graphically. It is estimated that total production in the U.S.A. will be only slightly over 100 million brl p.a. in 2035.

R. T.

850. How we can improve our discovery data. S. Harris. *Oil Forum*, 1956, **10**, 433–4.—In the past 10 years the U.S.A. has changed from a net exporter of petroleum to a net importer of more than one million b.d. New oil reserves are required. The total net gain of reserves since 1951 is only 3358 million brl. Current domestic consumption is *ca* 9 million b.d. By 1975 demand will increase probably to 12–14 million b.d. Since 1953 exploration and geophysical work in the U.S.A. have been declining. Improvements in instrumentation and field techniques have increased the effectiveness of seismograph surveying. In view of increased cost of instrumentation and field operations, and facing diminishing returns from the discovery of substantial reserves, the following solutions arise. Either an increase in the price of domestic

crude would stimulate exploration in the U.S.A., or the oil finders of tomorrow would receive intensive training. Oil finders cannot be taken out of cold storage, but must be kept in the front line of petroleum exploration. R. T.

851. Growth through conservation. O. Culberson. *Oil Forum*, 1956, **10**, 441–4.—In Sept 1956 Texas had 5557 oilfields with a total of 170,368 producing wells. Water flooding accounts for *ca* 5% of the nation's crude oil production; the figure expected by 1980 is approx 25%. Other fluids are proposed for increasing sweep efficiency of certain types of reservoirs. An experimental enriched gas drive is in progress in SW. Texas, using saleable hydrocarbons, 50% propane and 50% separator gas. If successful, some 200 reservoirs will benefit from this process. Ultimate recovery from such a reservoir might be increased by 475%. Additional recovery from one well could be 7,200,000 brl. Another programme for a different type of reservoir uses rich condensate gas. Casinghead gas—instead of being flared—is returned to the producing formation for reservoir pressure maintenance. Some reservoirs which produce gas and oil in ratios in excess of the Commission's prescription are closed, permitting transfer of allowables to other wells with a lower ratio. A warning note is issued—re natural gas export—on the danger of tying up gas supplies for 15–20 years by pipelines serving other states. R. T.

852. Logs and cores indicate porosity. C. R. Miller and C. B. Evans. *World Oil*, 1957, **144** (1), 115.—Exploitation techniques for determining porosity are listed and briefly described. These are the lab analysis of conventional and sidewall cores, computations from resistivity measurements from normal resistivity logs, limestone device, contact logs, laterologs, and computations from neutron logs. The quantitative use of the contact log for porosity estimation is outlined using nomographs which are given, and a comparison between computed porosity from the log and determinations on sidewall cores are given for some Oklahoma samples. These show close agreement between the 2 sets of measurements, in particular between the range 11–24%. 3 refs. C. A. F.

853. Water injection to give East Texas high oil recovery. L. J. Logan and A. Gibbon. *World Oil*, 1957, **144** (2), 46.—As a result of water injection it is thought that the ultimate recovery from the E. Texas field may be increased from 30–40 to 90% and that cumulative recovery will reach 5–6 billion brl, of which at least 600 million brl will be due to water injection. Abandonment is not expected for 50–75 years.

There are *ca* 20,000 producing wells, of which *ca* ½ are flowing; in Dec 1956 allowables were *ca* 20 b.d/well for 16 days/month.

In the injection programme salt water, which is produced with the oil, is piped to a treating plant and is then injected back into the Woodbine sand pay below oil–water level. Before secondary recovery salt water disposal had been a serious problem.

A map shows the extent to which the field has suffered water encroachment from the W. C. A. F.

854. For a change in the method of determination of efficient production and absolute free flow rate from a gas borehole. W. Kulczycki. *Nafta (Krakow)*, 1955, **11**, 233–7.—The formula $Q = C(P_s^2 - P_d^2)^n$ is too simple, since the flow depends on Reynold's No. In fact $\partial P/\partial L = \dfrac{\mu \cdot v \cdot d + 2g \triangle v^2 \cdot k}{k \cdot d}$.

In general, the form $P_s^2 - P_d^2 = aQ + bQ^2$ gives better results. P_s and P_d are the static and dynamic well pressures, a, b, C, and n are constants, Q is the rate of flow. M. S.

855. Secondary recovery of oil in United States and Canada. L. Finch, Jr., and F. M. Stewart. *Canad. Min. Metall. Bull.*, 1956, **49**, (536), 850–7.—Processes—with possibilities and limitations—for secondary recovery of oil in the U.S.A. and Canada are discussed with supporting diagrams. Typical recovery by primary methods—under basic energy sources, dissolved gas, water, and gas cap—is 10–25% of the oil in place for dissolved gas drive, generally higher for the others, Secondary recovery by water or gas injection, to supplement natural energy, amounts to 1·2–2 times the expected primary recovery. Procedure adaptable in a field depends on its primary performance and certain reservoir characteristics. It is estimated that >100 billion brl of oil is left in the ground after depletion of known fields. *Ca* 22% of U.S. oil production now comes from fields operating under injection. In 1953 *ca* 1·4 million b.d. came from such fields, more than double that in the early forties. Secondary recovery projects now in operation expect to boost the ultimate primary recovery from known pools of 73 billion to 80 billion brl, *ca* 10% increase. Unitized secondary recovery projects have proved successful. From these alone reserves of oil in the U.S.A. have increased by 3·5 billion brl. In Canada secondary recovery is not so widespread. Most of the large fields produce from Devonian reef by natural water drive, some have large gas caps. However, water in appreciable quantity is being injected in Redwater D-3, Leduc D-2, and Joarcum Viking reservoirs, and gas in Golden Spike D-3. Great possibilities are envisaged. R. T.

856. Network model of porous media. II. Dynamic properties of a single size tube network. I. Fatt. *J. Petrol. Tech.*, 1956, **8** (7), AIMME Tech. Paper No. 4272, 160–3.—Networks of resistors were used to simulate porous media. Resistors were removed from the network according to the capillary desaturation mechanism, and at each step the resistance was measured. The saturation for the wetting phase was equivalent to the fraction of the total number of resistors remaining, while the ratio of the resistance at a partial saturation to the resistance of the total network was the wetting phase relative resistance, the reciprocal of which was the wetting phase relative permeability.

The resistors removed were put in equivalent positions in a second network to represent the non-wetting phase, and thus the permeability to the non-wetting phase was simulated.

It was concluded from the measurements that the characteristic multiphase flow properties of porous media are a direct consequence of the interconnexion of the pores to give a network. The flow properties of the networks are a function of the network for a system of uniform pores. In a system of uniform pore sizes all relative flow properties which are functions of pore geometry only, such as relative permeability and relative resistivity, will be identical functions of the saturation. G. D. H.

857. Oil from under the sea. Anon. *Petrol. Press Serv.*, 1957, **24**, 8–11.—The search for oil under the sea—almost universal—is increasing. All known offshore fields have been located by geophysical methods; seismic work at sea costs *ca* ½ of that on shore. There are over 700 producing wells in the U.S. Gulf of Mexico—the main testing ground for offshore techniques—with a cumulative production to the end of 1956 of *ca* 100 million brl of crude oil and condensate, and over 210 billion ft³ of marketed natural gas. Owing to the high cost of offshore drilling—elaborate devices for rig support—only prospects of a big find can justify the expense. It is hoped that continued advance in techniques will bring bigger areas under exploration in all promising areas. Total recoverable oil reserves expected to be found in the U.S. Continental Shelf are currently estimated at 16 billion brl, equal to over ½ the present known U.S. reserves onshore. Search is being carried out offshore in Caribbean waters, the Persian Gulf, and the China sea, as discussed. R. T.

858. Japan accelerating domestic exploration also seeks foreign concessions. H. R. Connell. *Oil Forum*, 1956, **10**, 469–72.—In *Oil Forum* for Jan 1956 the activities of Teikoku Oil Co Ltd were described. More detailed information on exploration and crude oil production, and Teikoku's activities in coping with Japan's mounting needs for petroleum are given. The key to Japan's economic survival is her manufacturing ability. Success involves an uninterrupted cycle of events, raw materials purchase, sale of finished products, and further raw materials purchase. Japan's needs for petroleum —her chief energy source—will increase as her manufacturing horizons enlarge. Both availability and cost of petroleum affect her economy vitally. Efforts are made therefore to develop domestic sources and seek foreign participation. The chief producing stratigraphical horizons are Neocene Tertiary, 4 types of crude being obtained. At the end of 1955 Teikoku operated *ca* 3512 producing wells; daily output 824 metric tons. The principal fields—described and shown in a map—are in the Japan sea area in Hokkaido and Honshu. Relation between crude production and refinery capacity—at present balanced—may be upset by refinery modernization. Projects for increasing Japan's petroleum chemical needs are well advanced, in order to utilize the methane under the Niigata plain. Yabase oilfield is a prolific producer of natural gas rich in by-products. Annual crude production is approx 10% of present total proved reserves, and present crude production is only 3% of estimated requirements. Therefore, the total quantity of Japan's present known available crude oil is equiv to no more than 30% of one year's requirement.

R. T.

OILFIELD DEVELOPMENT

859. Petroleum in Western Canada. J. F. Caley. *Proc. Fourth World Petrol. Congr.*, 1955, **1**, 37–55.—Canada has recently acquired an outstanding position among the oil- and natural gas-producing countries of the world. W. Canada currently contributes *ca* 99% of Canada's yield. From a detailed description of the geological structure of this region evidence is given of prospective oil-bearing territories. Different types of presently known reservoirs in W. Canada are surveyed with regard to their geological age and distribution. Canada's oil and natural gas reserves are evaluated in the light of present knowledge, and some indication is given of the results to be expected from future exploration.

(Author's abstract.)

860. Pembina field is still expanding. Anon. *World Oil*, 1957, **144** (2), 76.—Pembina is now the largest oilfield in Canada and is producing *ca* ¼ of the total production from Alberta. It was discovered in 1953 *ca* 75 miles SW. of Edmonton, and *ca* 1400 wells have been drilled to date on *ca* 100,000 acres. Reserves are estimated to be over 1 billion brl, and hot water injection is now being carried out in a pilot project expected to boost recovery.

The structure is a stratigraphic trap producing from Cretaceous Cardium sand at *ca* 5200 ft, with 38° sweet oil. Crude is piped to Edmonton for refining or further distribution.

Drilling and completion practices are briefly noted.

C. A. F.

861. High success rate spurs Saskatchewan development. Anon. *World Oil*, 1957, **144** (2), 75.—Many fields, still under development, are producing in SE. Saskatchewan near the N. Dakota border. The original discovery in the area in 1952 was Ratcliff, and since then *ca* 480 wells have been drilled following geophysical and subsurface work. Proven recoverable reserves of the area are estimated at 356,500,000 brl, and typical structures are stratigraphical traps producing from the Charles (at 4400 ft) and Mission Canyon (at 4500 ft), both Mississippian. Spacing is 80-acre and max daily allowable/well is 60 brl, with a current total of *ca* 20,000 b.d. with most wells pumping. Drilling and completion programmes are briefly outlined.

High discovery ratio, good quality oil, and newly-opened pipeline have all stimulated development in this area.

C. A. F.

862. Colombia's favourable wildcat and discovery rate. E. Ospina-Racines. *Oil Forum*, 1956, **10**, 465.—The first discovery was the Infantas well in De Mares. When the Oil Code was enacted all wildcatting outside De Mares and Barco was in private oil lands; 80 wells were drilled. Wildcatting data are tabulated. At 31 Dec 1955 total oil discovered was 1354 million brl, 703 million produced, 650 million reserves. At this date 2816 wells had been drilled with average discovery/well 481,000 brl. Comparative figures for Venezuela are 12,000 million brl reserves after 9000 million brl cumulative output, an average of 972,000 brl/well for 16,466 wells drilled. U.S. figures are 85,000 million brl reserves plus cumulative output, *ca* 1 million wells drilled, giving an average of *ca* 85,000 brl/well. Steady rise in production from 111,428 to 126,289 b.d. in 13 months is due to Texas Petroleum Co's output from Velasquez. Present production is from 18 fields.

R. T.

863. Japan stepping up drilling programme and conservation. A. B. Waters. *World Oil*, 1956, **143** (7), 203.—Oil was first found in Japan in 1888, and peak production of 2,961,000 brl was reached in 1916. Most of the fields have been small, and are situated in the NW. part of Honshu along the W coast. The main field is Yabase (which produces *ca* 60% of Japan's current production), and gas injection and water flooding have been introduced here.

Most of the fields are faulted anticlines, and beds are Tertiary, mainly Pliocene and Miocene.

An extensive drilling programme is being carried out at Yabase, where the deepest pay is at *ca* 5575 ft, and seismic and exploratory drilling is being carried out in many areas.

C. A. F.

TRANSPORT AND STORAGE

864. Measurement and control of liquid levels and quantities in tanks and reservoirs. A. R. Myhill. *Mech. World*, 1957, **137** (3452), 110.—Some of the methods and appliances, *e.g.* dipping or sounding, observation of the level of liq in an external vertical glass gauge, float-operated indicators, and indicators operating without a float, used to determine the liq levels and quantities in tanks, etc., are described, together with the apparatus employed for the automatic control of liq levels.

D. K.

865. Reduction of evaporation losses of petroleum products. W. Gunia. *Nafta* (*Krakow*), 1955, **11**, 268–9.—Air space in tanks, excessive ventilation, and heat are causing losses on storage, costing the industry a lot of money. There is great need for charts of instructions and limits of permissible losses.

M. S.

866. 20,000-s.h.p. nuclear propulsion plant. R. P. Giblon and G. H. Kurz. *Mot. Ship*, 1957, **37** (442), 518.—Extracts from a paper entitled "Closed-cycle Gas Turbine Nuclear Propulsion Plants for Merchant Ships" read in New York to the Society of Naval Architects and Marine Engineers. The principal design features of a marine main propulsion plant incorporating a closed-cycle gas turbine and a nitrogen-cooled

power reactor are presented. The layout of the auxiliaries is included. The design is proposed as being suitable for a tanker. Numerous diagrams. D. K.

867. What happens when you mix crude oil and light ends in pipeline? R. Y. Young and S. A. Callahan. *Oil Gas J.*, 18.2.57, **55** (7), 157.—Results of studies by Cities Research and Development Co show that the physical properties of a mixture of crude oil and light ends varies considerably with the nature of the crude oil in the blend.

Methods employed and information from the study help design of new pipeline systems, and enable savings to be made on transportation. G. A. C.

868. 31,105 miles of pipeline is score for 1953–55. A. T. Coumbe and I. F. Avery. *Oil Gas J.*, 11.2.57, **55** (6), 116.—Tables show mileage of pipelines in the U.S.A., recapitulation of activity for 1952 and 1955, and mileage of various crude and product pipelines as at 1 Jan 1956. G. A. C.

869. El Paso's repairmen keep turbines on line. A. H. Carameros. *Pipe Line Ind.*, 1956, **5** (3), 34–9.—A description of El Paso Natural Gas Co's installation of 28 gas turbines. Unexpected problems, failures, etc., as illustrated and discussed, arose during initial operations. The special conditions were met with equipment modifications which promise high performance and economical operation. R. T.

870. Maintaining pipeline electrical equipment. M. Hyde and D. C. Washburn, Jr. *Pipe Line Ind.*, 1956, **5** (3), 40–3.—Improper maintenance leads to situations dangerous to life and property. Extra care is necessary to obtain max eff from modern electrical motors, switchgear, and controls. Regular inspection, cleanliness, and attention to operating procedures will result in eff, less lost time, and a lower repair bill. R. T.

871. Detergent cleaning a mountain pipeline. A. S. Olson. *Pipe Line Ind.*, 1956, **5** (3), 48–51.—Washing deposits—chiefly oils, Fe_2O_3, and SiO_2—out of a 14-mile section of 22-inch line in the Tehachapi Mountains is described. Careful planning was required in adapting a method—successful in flat country—to work in mountains. Flow eff increase from 71 to 90% was obtained at a cost of only $650/mile. R. T.

872. Satellite push-button pipeline stations. L. Resen. *Oil Gas J.*, 25.2.57, **55** (8), 111.—The operation is described of 2 new booster stations, and original booster station and equipment, on the Evangeline Products Systems 16-inch line from Port Arthur to Baton Rouge. G. A. C.

873. Italian pipeline crosses Apennines. Anon. *Pipe Line Ind.*, 1956, **5** (3), 60–2.—The new pipeline from the Italian port of Genoa to Milan has opened that highly industrialized area to direct shipments of crude oil from foreign ports. The corrosion-protected line can move 14 million brl of crude p.a. over the Apennines—climbing 2800 ft over the Bocchetta Pass—to the Rho refinery. The alternative supply route would require 150 tank trucks making the round trip each day from seaport to refinery. R. T.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

874. Recirculation of cooling water in petroleum refining. A. J. Brandel. *Industr. Engng Chem.*, 1956, **48**, 2156–8.—The methods used at the El Segundo refinery of the Standard Oil Co for the chemical treating and control of water concn in order to prevent corrosion, biological fouling, scale deposition, etc., are described. D. B. S.

875. Heat transfer from combustion products by forced convection. E. G. Jackson and J. K. Kilham. *Industr. Engng Chem.*, 1956, **48**, 2077–9.—The validity of heat transfer correlations when applied to combustion products at elevated temp was investigated and shown to be applicable up to gas temp of 1400° C. D. B. S.

876. Purifying chemically polluted waters. Various. *Industr. Engng Chem.*, 1956, **48**, 1404–58.—8 papers are presented dealing mainly with the transformation of carbon, hydrocarbon, nitrogen, and sulphur cpds by micro-organisms. D. B. S.

877. Separators for removal of oil from waste waters. S. Rachfal. *Nafta (Krakow)*, 1955, **11**, 237–41.—From Soviet sources several small and large separators are described with drawings and instructions. M. S.

878. Classification of refinery waste waters and their treatment. J. Chachucki *et al.* *Nafta (Krakow)*, 1955, **11**, 260–3.—The impurities found in waste waters are either hydrocarbons or naphthenic acids and their salts, or sulphonic acids and their salts. The latter 2 are soluble and difficult to remove. They are also toxic and cause emulsification of the former. Demulsification can be done using H_2SO_4, NaCl, $Ca(OH)_2$, $CaCl_2$, $Fe(OH)_3$, or $Al(OH)_3$, to be followed by filtration. The most efficient seems to be a bed of lime or ashes. M. S.

879. How Gulf purifies its boiler water. L. Resen. *Oil Gas J.*, 11.2.57, **55** (6), 106.—The water demineralization unit which removes cations and anions in 2 successive steps to supplement boiler feed water at the Port Arthur, Texas, refinery is described. Principles of the ion exchange are explained and flow diagrams of the water system and demineralization unit given. G. A. C.

880. Automatic process control. How and why? G. L. Farrar. *Oil Gas J.*, 18.2.57, **55** (7), 123.—Measuring element, controller, and final control element of the system are described. Controller action, proportional response, and rate response are discussed. G. A. C.

881. Automatic data handling. G. L. Farrar. *Oil Gas J.*, 18.2.57, **55** (7), 123.—The reliability and justification for automatic logging systems, which provide complete and accurate process information in digital form, is discussed and how the loggers operate is described. G. A. C.

882. Process stream analysers. G. L. Farrar. *Oil Gas J.*, 18.2.57, **55** (7), 127.—Physical and chemical analysers are discussed, with their accessories, and applications indicated. G. A. C.

883. Fuel oil heating pipe. Anon. *Petrol. Times*, 15.3.57, **61** (1555), 239.—Details are given of a new electrical method for heating fuel oil to prevent thickening on way to burners. The heater is in the form of tapes of glass fibre yarn, into which insulated resistance wire is woven during manufacture. G. A. C.

884. Vertical cylindrical fluid heating furnaces. Anon. *Petrol. Times*, 15.3.57, **61** (1555), 232.—The Petro-Chem Iso Flow furnace design, which can be made in the range from 250 million B.t.u/hr heat absorption down to the very smallest unit, is described. G. A. C.

885. No noxious ammonia odours here. W. E. Burns and R. R. Mullam. *Oil Gas J.*, 25.2.57, **58** (8), 129.—Pollution sources from the 450 tons/day ammonia plant of Phillips Chemical Co, Pasadena, Texas, are discussed and control measures described. An ammonia absorber has removed air pollution, and gases previously flared at some hazard are now burnt under boilers to save $15,000 p.a. in fuel bills.

G. A. C.

886. Low-cost practical smoke control. H. Martin. *Oil Gas J.*, 25.2.57, **55** (8), 116.—Design is given for a refinery flare to give smokeless operation. Oxygen supply, venturi-type burners, blowers, steam, and water spray are discussed.

G. A. C.

887. Electronic computers. G. L. Farrar. *Oil Gas J.*, 18.2.57, **55** (7), 133.—Types of computer, their operation, and application are reviewed. An outline is given of the Esso analogue computer at Belot refinery, Havana. G. A. C.

888. Gasoline plant computations by electronic computers. J. C. Schneider and R. C. Wright. *Proc. nat. Gas. Ass. Amer., 35th ann. Conv.*, 1956, 6–9.—A card-programme electronic computer has been applied to solution of gas engineering problems, such as pipeline network calculations and multicomponent flash vaporization calculations. A more complex application, process calculations of the type used to design natural gasoline plants, has been made using the electronic computer. The calculation routines required for the electronic computer are set up by unit operations, which allow re-use of the same procedure on different problems. The propane recovery performance of a 2-still gasoline plant at 2 lean oil rates over a range of gas volumes and summer to winter operating conditions. A study of economic lean oil circulation over a range of propane prices was made from results of the calculations. Other applications are planned for the future. (Authors' abstract.)

889. Reservoir considerations for economics of proposed natural gasoline plants. W. L. Horner. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 49–53.—Natural gasoline plants are justified primarily by adequate reserves determined by engineering studies. Reserves and deliverability of wet gas from any oilfield may be forecast with reasonable accuracy, given adequate reservoir information. The estimates require selection of the field operating methods, also dependent on reservoir engineering studies. Examples are given of several representative field-wide forecasts. (Author's abstract.)

890. Conventional but big . . . that's the San Juan plant. R. Cannon. *Petrol. Process.*, 1956, **11** (12), 48–50.—A new plant recently completed by the Pacific Northwest Pipeline Corpn draws gas from a 1487-mile long transmission line between the San Juan basin field and Pacific Northwest, U.S.A. Design capacity is 300,000 M.c.f/day of gas. Products at capacity will be: propane 77,000 gal/day; butane, 98,000 gal/day, and natural gasoline, 70,000 gal/day. In addition, a field dist unit ahead of the gas-processing plant will process at full capacity 118,000 gal/day of field dist from a field gathering system. Plant production will total 34,000 gal/day of liq, or 1·133 gal/M.c.f/day of gas and stabilizer column. The 20-tray column operates at 145 p.s.i. and 475° C. Gas-processing plant is a conventional absorption–fractionation system using a 40° API absorption oil and steam stripping. J. H.

DISTILLATION

891. Enter the ripple tray. Anon. *Chem. Engng*, 1957, **64** (1), 136–8.—Ripple trays can be used at higher liq loadings than bubble-cap trays and have greater flexibility than sieve trays. Replacing the bubble caps in a crude dist unit by ripple trays enabled the throughput to be increased by 60%. They consist of a perforated tray with sinusoidal waves pressed into the perforated sheet metal. The designed depth of the wave increases with liq loading. Ripple trays can be made in sections narrow enough to pass through an 18-inch manhole. Wave troughs are preferential liq discharge points, and eliminate the need for downcomers. Waves in adjoining trays are at 90° to ensure good liq distribution. The pronounced turbulence and lack of stagnant areas mean efficient contacting and help to keep the trays clean. Separating efficiency is maintained at 70–140% of design loading. Pressure drop of 1·5 cm of water/tray under vacuum is lower than that for bubble caps. D. H. A.

892. How to stretch your equilibrium data. J. O. Osburn. *Chem. Engng*, 1957, **64** (1), 242–50.—This article deals with the extension of vapour–liq equilibrium data by thermodynamics. Starting with the vapour pressure curves of the pure components, the equilibrium data can be obtained by means of the van Laar integration of the Gibbs–Duhem relationship between their activity coeff. One equilibrium value of vapour and liq compositions, *e.g.* azeotrope, and the b.p. of this mixture are also required. Worked examples show how to calculate the x–y diagram and predict azeotropes. The validity of the assumptions made in this method are discussed. D. H. A.

893. Automation of distillation in the laboratory. (In German.) H. Brandt, H. Röck, and F. Langers. *Chem. Ing. Tech.*, 1957, **29**, 86–91.—A description is given of various methods for the automatic control of lab size dist columns.

Methods described include control of boil-up rate by heat input to the still; control of jacket temp in order to maintain adiabatic conditions; control of reflux ratio; and a means of ensuring a constant water supply to the condenser. Methods of reducing fire hazards are also described.

P. J. K.

894. Fractionation your problem? Anon. *Petrol. Process.*, 1957, **12** (1), 58–9.—A boost in capacity of *ca* 150% in the original design throughput of a crude dist unit has resulted from a new fractionating tray design, trade-named the "Ripple Tray." The new tray is formed by pressing sinusoidal waves into flat, perforated, light-gauge sheet metal. No downcomers are required because the liq and the vapour pass through the perforations. The waves help redistribute liq as it flows from the bottom of one tray into the froth on the tray below in countercurrent contact with rising vapour; for the crude unit mentioned, operating data have shown no apparent limits on the operation at a crude throughput of 31,500 b.s.d. in comparison with a top loading of 20,000 b.s.d. using bubble caps. Fractionation in general has been reported comparable with the best obtained with the original bubble-cap installation when operated at the respective column loadings. J. H.

895. Custom refining is Cosden's speciality. L. Resen. *Oil Gas J.*, 25.2.57, **55** (8), 101.—Selective fractionation is used at Big Spring, Texas, refinery of Cosden Petroleum Corpn to remove pentanes from streams such as cat naphthas, Platformer feed, and alkylate to produce high octane, pentane-free motor fuel stocks.

Tables give overall plant balance, octane ratings, and feed stock analyses. G. A. C.

CRACKING

896. Commercial performance of fluid cracking catalysts. W. B. Wilson *et al.* *Industr. Engng Chem.*, 1956, **48**, 1982–9.—The rate of decline of surface area and pore vol of a silica–alumina cat in a commercial unit was investigated using a radioactive labelling technique on the fresh feed cat. The surface area of the fresh cat was found to decrease from 565 to 156 sq. m/g and its pore vol from 0·57 to 0·297 c.c/g during

the 24-hr period in which it was added. After one week and 5 weeks the values were 130 and 0·270, and 103 and 0·265 respectively. The loss of surface area was found to be more rapid than the loss in pore vol during the initial deactivation. D. B. S.

897. Update your reactor design method. J. C. Chu. *Chem. Engng*, 1957, **64** (1), 235–40.—Rate of conversion rather than percentage yield is a critical factor in determining the optimum size of an industrial reactor. The way in which the other relevant factors affect the optimum design and their evaluation, either with the help of a computer or by a simplified hand method, are discussed. The limitations of reactor designing by kinetic correlations are stated, and the caution necessary in using empirical correlations is emphasized. D. H. A.

HYDROGENATION

898. Selective analytical hydrogenation of olefinic distillates. H. I. Waterman, A. B. R. Weber, and C. Zweekhorst. *J. Inst. Petrol.*, 1956, **42** (396), 349–54.—In an attempt to find a suitable cat for selective hydrogenation, experiments were carried out at 10 and 100 atm initial pressure, one hr reaction time at 20°–300° C, and with a cat to oil ratio of 1 : 4. The starting materials were kerosine fractions obtained from the platforming of medicinal oil. Mo on active carbon (100 atm and 300° C) and platinum on silica–alumina (10 atm and 120° C) were found to be suitable cat. Other cat tested, Ni on kieselguhr, Raney Ni, Pd on active carbon, and platforming cat were found to be insufficiently selective. 18 refs. C. B.

POLYMERIZATION

899. Urethane plastics. Various. *Industr. Engng Chem.*, 1956, **48**, 1383–91.—A comprehensive review of the uses, physical and chemical properties, manufacture, and future possibilities of urethane rubbers. Comparison with natural, vinyl, and polystyrene rubbers is also made. D. B. S.

ISOMERIZATION

900. A new isomerization process. Anon. *Inst. Petrol. Rev.*, 1957, **11** (123), 81.—The Kellogg Iso-Kel process for increasing yield of high octane motor spirits by upgrading combined streams of pentane and hexane fractions, as well as natural gasolines, is described.

A flow chart is provided, and a table shows isomerization of pentane–hexane fraction from commercial stocks. G. A. C.

SPECIAL PROCESSES

901. Better inhibitor sweetening. L. D. Rampins and M. J. Gorham. *Petrol. Process.*, 1957, **12** (1), 46–9.—Tidewater Oil Co Associated, California, have developed a process whereby inhibitor sweetening is accelerated, the peroxide contact in the sweet naphtha reduced, the product quality improved, and substantial savings realized through decreased usage of inhibitor and TEL. Light cat gasoline is inhibited immediately after production (phenylene diamine type, 7·5 lb/1000 brl). The gasoline is then contacted with a mixture of caustic, doctor soln, and air, and this mixture flows to a run-down tank. Caustic is withdrawn continuously from the bottom of the tank and recirculated. J. H.

902. Recent developments in petroleum chemicals. II. P. N. Collinswood, C. F. M. Mackintosh, and H. Steiner. *Petrol. Times*, 1.3.57, **61** (1554), 195.—Developing trends in the ethylene market in America are compared with those in Europe. In the U.K., Shell are building a unit to yield 25,000 tons p.a. in 1958, and ICI are adding to their plant to bring production up to 90,000 tons p.a. by 1959. Other British concerns are likewise engaged, and in France a major expansion programme is being undertaken. W. Germany, the Netherlands, and Denmark are also to produce ethylene oxide and other petroleum chemicals. G. A. C.

903. Synthetic rubber production in the U.K. Anon. *Petrol. Times*, 1.3.57, **61** (1554), 205.—A brief description is given of the Fort Dunlop plant for the manufacture of 1500 tons of synthetic rubber from the monomers styrene and butadiene. G. A. C.

904. One-stage selective cresol refining. S. Weklar. *Nafta (Krakow)*, 1955, **11**, 241–2.—Installation consists of extractor, recovery unit, and stabilizer–separator. Up to 10% of water in cresol allows working between 40° and 90° C. Recovery by dist at 99° C yields the solvent mixture required for the extractor. 2-stage refining would obviate subsequent use of H_2SO_4, which at present is necessary. M. S.

METERING AND CONTROL

905. Dielectric constant continuous analysers in petroleum refining. N. F. Chamberlain *et al. Industr. Engng Chem.*, 1956, **48**, 1990–5.—The instrument is particularly suitable for the control of SO_2 solvent extraction units, and both solvent and phenol dewaxing units. The analysers are accurate, reliable, easy to maintain, and very fast acting towards changes in stream composition. Other features and applications are discussed. D. B. S.

906. Some data processing and engineering calculations with slow to medium speed computers. J. W. Walker. *J. Petrol. Tech.*, 1956, **8** (12), 17–23.—The problems discussed in terms of techniques employing computers are curve fitting, water influx calculations, material balance studies, core analysis data and production data studies, vapour–liq equilibrium flash calculations, and the preparation of the annual reserve report. The breakdown of some of the problems and their presentation in a form suitable for the machine operations are described. Examples of the card layouts are given, together with an indication of the type of machine employed for a given calculation. G. D. H.

907. Mathematical engineering at Phillips Petroleum Company. J. R. Cobb and R. L. McIntire. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 10–14.—Phillips Petroleum Co has established a mathematical engineering group in the Research and Development Dept to solve problems in process design, equipment design, production, operations research, and quality control, using automatic computers. The present installation uses a medium-sized computer of the magnetic drum type. With this machine, a step-by-step solution of a 50-stage fractionator can be produced within 2 hours. By comparison, the former machine (a card-programmed calculator) could compute a solution in 10–20 hr. A man making a hand solution would never obtain the precision of the machines, but even a rough step-by-step calculation checking several reflux ratios would probably require 6 weeks to 3 months.

One of the problems which lends itself particularly well to machine calculations is absorber design. The complications of intercoolers, widely-varying vapour rates, and the absorbing effect of heavy components in the feed are easily computed. The machine solution is simply a series of passes down the column for different assumptions of the overhead composition until the calculated vapour to the feed step equals the absorber feed. In the case of reboiled absorbers, revisions in the product streams are made by comparing the vapour streams at the feed step as calculated from both the overhead and the bottoms product. Each step is calculated by trial and error. A temp on the step is assumed, and a corresponding heat balance is made until a temp is found which will satisfy both heat and material balances.

(Authors' summary.)

PRODUCTS

CHEMISTRY AND PHYSICS

908. Mechanism of friction and shear resistance of adsorbed monomolecular lubricant films. A. Bailey. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1313–24.—Mol smooth cleaved mica surfaces were bent and mounted as crossed cyl and extent of contact zone between them determined interferometrically. Normal and tangential loads were applied both to clean specimens and to specimens coated with a monomolecular film of Ca stearate. Force required to shear junction was determined in both cases and found to be 10 kg/mm² and 250 g/mm² respectively. As electron microscope examination shows absence of deterioration of mica surface in the latter case, the still appreciable shear force required represents shear resistance of lub film. V. B.

909. Prediction of physical and physico-chemical properties of chemical compounds. E. Bauman. *Nafta (Jugoslavia)*, 1956, **7** (11), 335–44.—Methods are summarized for estimating critical constants, densities, vapour pressure, specific heat, heats of fusion, vaporization, and combustion. Physical properties, visc, and thermal conductivity may also be predicted.

Knowing only the mol structure and the atm b.p., the physical properties of a cpd may be estimated by the methods described. (Author's abstract.)

910. What is in store for process engineering. E. I. Organick. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 3–5.—Electronic computers can revolutionize aspects of process engineering in the natural gasoline industry just as they have in accounting and other data processing fields. In fact, the revolution in process engineering has already begun. The quality and quantity of engineering achievement (productivity) is rising, due to the use of electronic computers.

Computers have proved useful on two levels: to help the engineer in setting up his problem, and to solve the problem once it is set up. This twofold quality, combined with the ability of the new machines to store and readily retrieve vast amounts of data and instructions, attracts us compellingly to the electronic computer for really elaborate calculations. (Author's summary.)

911. Gas chromatography. D. H. Desty. *Nature, Lond.*, 1957, **179**, 241.—Report of a Committee of the Hydrocarbon Research Group of the IP. The report contains sections on nomenclature, presentation of retention values, column resolution, and vapour detectors.

In measuring retention values the following cpds should be used as internal standards: *n*-butane, 2,2,4-trimethyl pentane, benzene, *p*-xylene, naphthalene, M.E.K., *cyclo*hexanone, *cyclo*hexanol. H. C. E.

912. Vinyl type polymerization at solid surfaces and with complex catalysts. F. Eirich and H. Mark. *J. Colloid Sci.*, 1956, **11**, 748–66.—The stereo-specific high polymer syntheses and their relation to heterogeneous catalysis are briefly discussed. The likely courses of reactions during the formation of all-*cis* polybutadiene, of crystalline polypropylene oxide, and of the poly-olefins during Ziegler-type syntheses are analysed in detail.

The reaction mechanism can be divided into 2 parts: acceleration and direction of reaction. The primary basis for acceleration appears to be co-ordination or complexing of reactants to the same or an adjacent centre. The activation process becomes sub-divided into several steps, each with a much lower activation energy than that of the reaction as a whole. It seems essential in the directional part of the mechanism for the reactive complex to be situated on a surface so that one of the reactants is fixed with regard to its internal rotational degrees of freedom. The molecule to be added may then lose its energy to the surface and drop into a definite position of lowest energy with respect to the other reactants on the surface. H. C. E.

ANALYSIS AND TESTING

913. Systematic scheme of semi-micro qualitative analysis for anionic surface-active agents. H. Holness and W. R. Stone. *Analyst*, 1957, **82**, 166–76.—Tests are described for distinguishing anionic from certain types of cationic or non-ionic surface-active agents. A scheme of analysis enables a single anionic agent to be classified into one of 21 commonly-occurring groups. These include oil- and water-soluble petroleum sulphonates. Only a few mg of active material is required, and analysis usually takes <1 hr. W. A. M.

914. Correlation of oil horizons by trace elements in crude oil ashes. J. Zlotnicka. *Nafta (Krakow)*, 1955, **11**, 275–7.—Crudes contain some 40 elements, of which apart from C, H, O, S, N there are some 10 common ones. It is possible to classify crudes according to the composition of their ashes. From the living organisms which form crude petroleum come Zn, Sn, W, Au, Cu, as well as V. Method employed to obtain ash is given. Work was done using Polish chemicals, German spectroprojector and film, and Russian reference textbooks. In samples from field "F–P" 28 elements were identified. Ni, V, Ti, Ca, Mg, Mn, Al, Si, Cu, Cr, Ba are present in all crudes. Zn and Sn are characteristic of horizon II, and their absence of horizon I of field "F–P." Field "W–T" shows presence of the same elements as "F–P" and 3 more. All the same as above except Cr appear in all crudes. 3 horizons can be identified by reference to Zn and Sn. Similar successful work has been done with samples from field "K–I," which points to the sufficiency of spectrography as a means of identification of horizons. M. S.

915. Developments in light hydrocarbon analysis. W. J. Podbielniak and S. I. Preston. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 30–6.—Accuracy and other special requirements of any method of light hydrocarbon analysis are discussed. Improvements in low-temp dist are described, including the use of a special thermal conductivity cell arrangement to trace dist composition curve with material gain in accuracy and with reduction in analysis time compared with usual thermocouple indication. The applications of vapour-phase chromatographic apparatus in the natural gasoline industry are discussed, including continuous plant stream analysers. (Authors' abstract.)

916. A contribution to the problem of piston blow-by of combustion gases and to the accurate evaluation of used crankcase oils. E. H. Kadmer and H. Mauser. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 147–67.—The evaluation of motor field tests is preferably based on the analysis of the oils used and the determination of characteristic and extraneous ageing components correlated to the tested road distance and the needed quantity of oil (supply and addition). In the present paper it is proposed to consider also the piston blow-by and the influence of the blow-by gases on the deterioration of the oil. With regard to the highly developed filter methods it is advisable to determine the contamination rate, not only by examining the oil, but also by analysis of the filter residue. For the road tests 2 passenger cars with carburator engines, one passenger car with diesel motor, and 3 diesel trucks were used. All the vehicles had already been in long service and were used until overhauling was necessary. So it was easy to

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the 24-hr period in which it was added. After one week and 5 weeks the values were 130 and 0·270, and 103 and 0·265 respectively. The loss of surface area was found to be more rapid than the loss in pore vol during the initial deactivation. D. B. S.

897. Update your reactor design method. J. C. Chu. *Chem. Engng*, 1957, **64** (1), 235–40.—Rate of conversion rather than percentage yield is a critical factor in determining the optimum size of an industrial reactor. The way in which the other relevant factors affect the optimum design and their evaluation, either with the help of a computer or by a simplified hand method, are discussed. The limitations of reactor designing by kinetic correlations are stated, and the caution necessary in using empirical correlations is emphasized. D. H. A.

HYDROGENATION

898. Selective analytical hydrogenation of olefinic distillates. H. I. Waterman, A. B. R. Weber, and C. Zweekhorst. *J. Inst. Petrol.*, 1956, **42** (396), 349–54.—In an attempt to find a suitable cat for selective hydrogenation, experiments were carried out at 10 and 100 atm initial pressure, one hr reaction time at 20°–300° C, and with a cat to oil ratio of 1 : 4. The starting materials were kerosine fractions obtained from the platforming of medicinal oil. Mo on active carbon (100 atm and 300° C) and platinum on silica–alumina (10 atm and 120° C) were found to be suitable cat. Other cat tested, Ni on kieselguhr, Raney Ni, Pd on active carbon, and platforming cat were found to be insufficiently selective. 18 refs. C. B.

POLYMERIZATION

899. Urethane plastics. Various. *Industr. Engng Chem.*, 1956, **48**, 1383–91.—A comprehensive review of the uses, physical and chemical properties, manufacture, and future possibilities of urethane rubbers. Comparison with natural, vinyl, and polystyrene rubbers is also made. D. B. S.

ISOMERIZATION

900. A new isomerization process. Anon. *Inst. Petrol. Rev.*, 1957, **11** (123), 81.—The Kellogg Iso-Kel process for increasing yield of high octane motor spirits by upgrading combined streams of pentane and hexane fractions, as well as natural gasolines, is described.

A flow chart is provided, and a table shows isomerization of pentane–hexane fraction from commercial stocks. G. A. C.

SPECIAL PROCESSES

901. Better inhibitor sweetening. L. D. Rampins and M. J. Gorham. *Petrol. Process.*, 1957, **12** (1), 46–9.—Tidewater Oil Co Associated, California, have developed a process whereby inhibitor sweetening is accelerated, the peroxide contact in the sweet naphtha reduced, the product quality improved, and substantial savings realized through decreased usage of inhibitor and TEL. Light cat gasoline is inhibited immediately after production (phenylene diamine type, 7·5 lb/1000 brl). The gasoline is then contacted with a mixture of caustic, doctor soln, and air, and this mixture flows to a run-down tank. Caustic is withdrawn continuously from the bottom of the tank and recirculated. J. H.

902. Recent developments in petroleum chemicals. II. P. N. Collinswood, C. F. M. Mackintosh, and H. Steiner. *Petrol. Times*, 1.3.57, **61** (1554), 195.—Developing trends in the ethylene market in America are compared with those in Europe. In the U.K., Shell are building a unit to yield 25,000 tons p.a. in 1958, and ICI are adding to their plant to bring production up to 90,000 tons p.a. by 1959. Other British concerns are likewise engaged, and in France a major expansion programme is being undertaken. W. Germany, the Netherlands, and Denmark are also to produce ethylene oxide and other petroleum chemicals. G. A. C.

903. Synthetic rubber production in the U.K. Anon. *Petrol. Times*, 1.3.57, **61** (1554), 205.—A brief description is given of the Fort Dunlop plant for the manufacture of 1500 tons of synthetic rubber from the monomers styrene and butadiene. G. A. C.

904. One-stage selective cresol refining. S. Weklar. *Nafta (Krakow)*, 1955, **11**, 241–2.—Installation consists of extractor, recovery unit, and stabilizer–separator. Up to 10% of water in cresol allows working between 40° and 90° C. Recovery by dist at 99° C yields the solvent mixture required for the extractor. 2-stage refining would obviate subsequent use of H_2SO_4, which at present is necessary. M. S.

METERING AND CONTROL

905. Dielectric constant continuous analysers in petroleum refining. N. F. Chamberlain *et al.* *Industr. Engng Chem.*, 1956, **48**, 1990–5.—The instrument is particularly suitable for the control of SO_2 solvent extraction units, and both solvent and phenol dewaxing units. The analysers are accurate, reliable, easy to maintain, and very fast acting towards changes in stream composition. Other features and applications are discussed. D. B. S.

906. Some data processing and engineering calculations with slow to medium speed computers. J. W. Walker. *J. Petrol. Tech.*, 1956, **8** (12), 17–23.—The problems discussed in terms of techniques employing computers are curve fitting, water influx calculations, material balance studies, core analysis data and production data studies, vapour–liq equilibrium flash calculations, and the preparation of the annual reserve report. The breakdown of some of the problems and their presentation in a form suitable for the machine operations are described. Examples of the card layouts are given, together with an indication of the type of machine employed for a given calculation. G. D. H.

907. Mathematical engineering at Phillips Petroleum Company. J. R. Cobb and R. L. McIntire. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 10–14.—Phillips Petroleum Co has established a mathematical engineering group in the Research and Development Dept to solve problems in process design, equipment design, production, operations research, and quality control, using automatic computers. The present installation uses a medium-sized computer of the magnetic drum type. With this machine, a step-by-step solution of a 50-stage fractionator can be produced within 2 hours. By comparison, the former machine (a card-programmed calculator) could compute a solution in 10–20 hr. A man making a hand solution would never obtain the precision of the machines, but even a rough step-by-step calculation checking several reflux ratios would probably require 6 weeks to 3 months.

One of the problems which lends itself particularly well to machine calculations is absorber design. The complications of intercoolers, widely-varying vapour rates, and the absorbing effect of heavy components in the feed are easily computed. The machine solution is simply a series of passes down the column for different assumptions of the overhead composition until the calculated vapour to the feed step equals the absorber feed. In the case of reboiled absorbers, revisions in the product streams are made by comparing the vapour streams at the feed step as calculated from both the overhead and the bottoms product. Each step is calculated by trial and error. A temp on the step is assumed, and a corresponding heat balance is made until a temp is found which will satisfy both heat and material balances. (Authors' summary.)

PRODUCTS

CHEMISTRY AND PHYSICS

908. Mechanism of friction and shear resistance of adsorbed monomolecular lubricant films. A. Bailey. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1313–24.—Mol smooth cleaved mica surfaces were bent and mounted as crossed cyl and extent of contact zone between them determined interferometrically. Normal and tangential loads were applied both to clean specimens and to specimens coated with a monomolecular film of Ca stearate. Force required to shear junction was determined in both cases and found to be 10 kg/mm² and 250 g/mm² respectively. As electron microscope examination shows absence of deterioration of mica surface in the latter case, the still appreciable shear force required represents shear resistance of lub film. V. B.

909. Prediction of physical and physico-chemical properties of chemical compounds. E. Bauman. *Nafta* (*Jugoslavia*), 1956, **7** (11), 335–44.—Methods are summarized for estimating critical constants, densities, vapour pressure, specific heat, heats of fusion, vaporization, and combustion. Physical properties, visc, and thermal conductivity may also be predicted.

Knowing only the mol structure and the atm b.p., the physical properties of a cpd may be estimated by the methods described. (Author's abstract.)

910. What is in store for process engineering. E. I. Organick. *Proc. nat. Gas Ass. Amer.*, 35*th ann. Conv.*, 1956, 3–5.—Electronic computers can revolutionize aspects of process engineering in the natural gasoline industry just as they have in accounting and other data processing fields. In fact, the revolution in process engineering has already begun. The quality and quantity of engineering achievement (productivity) is rising, due to the use of electronic computers.

Computers have proved useful on two levels: to help the engineer in setting up his problem, and to solve the problem once it is set up. This twofold quality, combined with the ability of the new machines to store and readily retrieve vast amounts of data and instructions, attracts us compellingly to the electronic computer for really elaborate calculations.
(Author's summary.)

911. Gas chromatography. D. H. Desty. *Nature, Lond.*, 1957, **179**, 241.—Report of a Committee of the Hydrocarbon Research Group of the IP. The report contains sections on nomenclature, presentation of retention values, column resolution, and vapour detectors.

In measuring retention values the following cpds should be used as internal standards: *n*-butane, 2,2,4-trimethyl pentane, benzene, *p*-xylene, naphthalene, M.E.K., *cyclo*hexanone, *cyclo*hexanol. H. C. E.

912. Vinyl type polymerization at solid surfaces and with complex catalysts. F. Eirich and H. Mark. *J. Colloid Sci.*, 1956, **11**, 748–66.—The stereo-specific high polymer syntheses and their relation to heterogeneous catalysis are briefly discussed. The likely courses of reactions during the formation of all-*cis* polybutadiene, of crystalline polypropylene oxide, and of the poly-olefins during Ziegler-type syntheses are analysed in detail.

The reaction mechanism can be divided into 2 parts: acceleration and direction of reaction. The primary basis for acceleration appears to be co-ordination or complexing of reactants to the same or an adjacent centre. The activation process becomes sub-divided into several steps, each with a much lower activation energy than that of the reaction as a whole. It seems essential in the directional part of the mechanism for the reactive complex to be situated on a surface so that one of the reactants is fixed with regard to its internal rotational degrees of freedom. The molecule to be added may then lose its energy to the surface and drop into a definite position of lowest energy with respect to the other reactants on the surface. H. C. E.

ANALYSIS AND TESTING

913. Systematic scheme of semi-micro qualitative analysis for anionic surface-active agents. H. Holness and W. R. Stone. *Analyst*, 1957, **82**, 166–76.—Tests are described for distinguishing anionic from certain types of cationic or non-ionic surface-active agents. A scheme of analysis enables a single anionic agent to be classified into one of 21 commonly-occurring groups. These include oil- and water-soluble petroleum sulphonates. Only a few mg of active material is required, and analysis usually takes <1 hr. W. A. B.

914. Correlation of oil horizons by trace elements in crude oil ashes. J. Zlotnicka. *Nafta* (*Krakow*), 1955, **11**, 275–7.—Crudes contain some 40 elements, of which apart from C, H, O, S, N there are some 10 common ones. It is possible to classify crudes according to the composition of their ashes. From the living organisms which form crude petroleum come Zn, Sn, W, Au, Cu, as well as V. Method employed to obtain ash is given. Work was done using Polish chemicals, German spectroprojector and film, and Russian reference textbooks. In samples from field "F–P" 28 elements were identified. Ni, V, Ti, Ca, Mg, Mn, Al, Si, Cu, Cr, Ba are present in all crudes. Zn and Sn are characteristic of horizon II, and their absence of horizon I of field "F–P." Field "W–T" shows presence of the same elements as "F–P" and 3 more. All the same as above except Cr appear in all crudes. 3 horizons can be identified by reference to Zn and Sn. Similar successful work has been done with samples from field "K–I," which points to the sufficiency of spectrography as a means of identification of horizons. M. S.

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916. A contribution to the problem of piston blow-by of combustion gases and to the accurate evaluation of used crankcase oils. E. H. Kadmer and H. Mauser. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 147–67.—The evaluation of motor field tests is preferably based on the analysis of the oils used and the determination of characteristic and extraneous ageing components correlated to the tested road distance and the needed quantity of oil (supply and addition). In the present paper it is proposed to consider also the piston blow-by and the influence of the blow-by gases on the deterioration of the oil. With regard to the highly developed filter methods it is advisable to determine the contamination rate, not only by examining the oil, but also by analysis of the filter residue. For the road tests 2 passenger cars with carburator engines, one passenger car with diesel motor, and 3 diesel trucks were used. All the vehicles had already been in long service and were used until overhauling was necessary. So it was easy to

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clear up the influence of some factors essential to the lubrication condition, without prejudice to the lubricant.
(Authors' abstract.)

917. Determination of halogen derivatives of hydrocarbons in air. M. Moskalowska. *Nafta (Krakow)*, 1955, **11**, 255–7.—The Barisol dewaxing process involves the use of dichloroethane. To detect this in air a recording apparatus was ordered but had not arrived, so the Medical Institute of Labour in Lodz perfected Elkins' method; later the author and A. Szczurkowski developed a method by which dichloroethane (or any other halogenated hydrocarbon) dissolved in ethyl alcohol is burned and liberated Cl_2 is reduced to HCl by arsenious acid and detected by $AgNO_3$. Details of apparatus are given with drawings. M. S.

918. Recent technical developments. A new electrical torsiograph. Anon. *Petrol. Times*, 15.3.57, **61** (1555), 254.—A new torsional vibration pick-up, used in conjunction with a cathode-ray oscillograph and suitable pre-amplifier, enables diagrams and recordings of the amplitude of oscillation of a shaft to be directly obtained. G. A. C.

919. Wax polish technology and testing methods. C. L. Jones. *Paint Technol.*, 1957, **21** (232), 43.—This paper, together with those published in *Paint Technol.*, 1956, **20** (229), 361, and 1957, **21** (232), 9, represents the text of 3 lectures on the examination of waxes and wax-containing materials given at Acton Technical College.

Waxes are usually blended for use as protective coatings or set as pastes with organic solvents and oils to make polishes, etc. Various types of wax polish and methods of testing and evaluation of them are discussed. D. K.

920. Statistical quality control in a petroleum control laboratory. J. M. Duncan. *Bull. Amer. Soc. Test. Mat.*, 1957, **219**, 40–3.—Statistical quality control (SQC) is employed to provide additional assistance in interpreting and improving lab test data. A 2-part programme (SQC)—Reference Sample and Check Sample—keeps the lab management informed on the quality of test results. Test variations are random or inherent in the process, and are due to small undetectable and uncontrollable causes, or assignable variations due to causes which may be found and corrected. Separation of the 2 types is accomplished with control charts, which relate test results to the probability of their occurrence, since random variations follow the laws of probability, but assignable do not. A test is said to be under control statistically if the only variations encountered are random ones. As a result of this control testing precision has been improved and greater confidence in lab results imparted. 9 refs. R. T.

921. Radioisotopes in refining. 5. Are you overlooking nuclear radiation? F. H. Low. *Oil Gas J.*, 4.2.57, **55** (5), 121.—The obtaining of adequate information in the application of nuclear radiation is discussed.

Techniques to be employed in the choice of an isotope in the study of a complex organic cpd, in the routine testing of lub oil in piston-wear measurements, in cat flow, and fluid cat density are outlined. G. A. C.

CRUDE OIL

922. Mineral components of crude oils and their emergence in the ashes of Polish crudes. W. Kisielew and Z. Gregorowicz. *Nafta (Krakow)*, 1955, **11**, 258–9.—Ashes of 14 crudes were examined spectroscopically. 10–20 elements were found in each. These can be divided into either (1) accidental and (2) original (present in the organisms which were changed into petroleum), in particular Ni and V or, depending on quantity, into (1) principal (*e.g.* Fe, Ca, Si, Mg, Al, etc.) and (2) remainder. M. S.

GAS

923. Gas production and field processing equipment. C. A. Lavery. *Canad. Min. metall. Bull.*, 1956, **49** (534), 695–703.—Gas processing in the U.S.A. and Canada is reviewed under 2 general groups: wellhead production equipment and field processing. The former concerns indirect heaters, separators, knockouts, and special versions of this equipment. The latter includes field processing equipment for handling natural gas, *i.e.* equipment necessary to complete gas preparation for sale to pipeline or for valuable component recovery. This includes glycol dehydration, solid desiccant dehydration, low-temp separation, mechanical refrigeration, and desorption-stabilization. Conventional and large-scale plant processes are not included. Plant operations are described with supporting illustrations and flow diagrams. The gas production operation will commence shortly in W. Canada. R. T.

924. Conversion of light hydrocarbons for industrial utilization. (In French.) M. Ringuet. *Chim. et Industr.*, 1957, **77**, 91–9.—Brief consideration of theoretical basis of reforming of products such as natural gas, refinery gas, and firedamp is followed by short descriptions, with schematic flow diagrams and typical product analyses, of processes divided into 3 groups, externally heated, cyclically heated, autothermic. V. B.

925. Influence of diborane on flame speed of propane–air mixtures. P. F. Kurz. *Industr. Engng Chem.*, 1956, **48**, 1863–8.—Quantities of diborane less than 5 vol % of the fuel produced no significant changes in the flame speed, probably due to the propane inhibiting the diborane–air reaction in both lean and rich mixtures. When diborane was present in larger amounts it acted as a secondary fuel and burnt preferentially in the rich mixtures. D. B. S.

926. Yellow-tipping of bunsen burner flames and related exchangeability of fuels in gas utility systems. J. Grumer, M. E. Harris, and V. R. Rowe. *Industr. Engng Chem.*, 1956, **48**, 2052–62.—The flame characteristics of a large number of fuel gases were investigated with respect to the yellow tipping and the flashback and blow-off of burner flames in free air at atmospheric pressure. For each fuel and design of burner there was a minimum characteristic fuel : air ratio at which a yellow tip was produced. The results may be used to estimate the exchangeability of fuel gases in a pipeline system so as to cause minimum disturbance. D. B. S.

ENGINE FUELS

927. Effect of boron compounds on combustion processes. E. C. Hughes *et al.* *Industr. Engng Chem.*, 1956, **48**, 1858–62.—Boron additives and, in particular, all-bromide TEL and boron mixtures have been found to improve the combustion characteristics of gasoline in reciprocating engines and also reduce the amount of combustion zone deposit. In addition the surface ignition frequency was reduced and the F-1 O.N. increased. D. B. S.

928. Visible emission spectra of two-stage flames of diethyl ether produced in a flat-flame burner. W. G. Agnew and J. T. Agnew. *Industr. Engng Chem.*, 1956, **48**, 2224–31.—Low-temp combustion using a diethyl ether fuel was studied by spectroscopic methods using a flat-flame burner. Normal, cool, and second-stage flames were identified and investigated at varying ether–air ratios. In the range from 3200 to 5100 Å the cool-flame spectrum at all ratios consisted of formaldehyde bands superimposed on a strong background, additional bands between 5100 and 6500 Å could not be identified.

The spectrum of the richest second-stage flame was similar

to the cool-flame radiation except that the intensity was greater over the range 4600–4700 Å and there was no unidentified radiation between 5100 and 6500 Å. The leaner second-stage flames approached the conditions of normal flames, the formaldehyde spectrum being slowly replaced by an intense spectrum of HCO and CH. The results also show that the theory that yellow-flame luminosity is due to black body emission from solid particles is uncertain. D. B. S.

929. Effect of present-day fuels on air pollution. P. P. Mader *et al. Industr. Engng Chem.*, 1956, **48**, 1508–11.—Individual hydrocarbons were found to produce varying amounts of noxious pollutants when exposed to u.v. radiation. This variation depended on the position of the double bond, and olefins having an internally bonded or branched chain α-type of structure were particularly susceptible to oxidn action to form aldehydes, peroxides, and ozone. This type of olefin structure occurs more frequently in cat-cracked than in thermally-cracked fuels, and consequently present-day fuels tend to increase the smog problem. D. B. S.

930. Theory of tetra-ethyl lead action. A. Ross and E. B. Rifkin. *Industr. Engng Chem.*, 1956, **48**, 1528–31.—The mechanism by which TEL suppresses engine knock was investigated by using 2 methods of lead addition. It was found that fuels containing a very fine colloidal lead suspension showed no anti-knock activity, but that the addition of lead in the form of a smoke to the intake manifold produced a considerable anti-knock effect. Reasons for this observation are discussed, and it is concluded that as the presence of inorganic lead has an effect, the decomposition of TEL may be an important factor in its anti-knock qualities. The question as to whether the action is one of surface deactivation or chemical reaction remains unsolved. D. B. S.

931. Decomposition of tetra-ethyl lead in an engine. E. B. Rifkin and C. Walcutt. *Industr. Engng Chem.*, 1956, **48**, 1532–9.—The decomposition was studied in a CFR engine using 3 different fuels, 6 additives, and engine speeds varying between 200 and 900 rev/min. The decomposition which occurred at temp between 300° and 500° C was found to be independent of both the fuel and the additive used, although indirectly they affected the rate of reaction because of their effect on the temp of the engine gases. The reaction was first order with respect to TEL, and an equation for the reaction velocity constant is given. The decomposition products of the reaction are also discussed. D. B. S.

932. Ignition accelerators and auto-ignition environment. R. W. Hurn and K. J. Hughes. *Industr. Engng Chem.*, 1956, **48**, 1904–8.—O.N. alone does not give sufficient information regarding the ignition-promoting effects of additives under different engine-operating conditions. The responses of 4 accelerators (amyl nitrate; 2 : 2-dinitropropane; ethyl-N-*iso*propyl-N-nitrocarbamate; and di-*tert*-butyl peroxide) to changes in fundamental pressure, temp, and conc conditions that prevail during the ignition period were investigated. 3 different fuels were used, and the results obtained may be used to predict the effects of ignition improvers under abnormal conditions. D. B. S.

933. Evaluation of alkylated *p*-(*p*-nitrophenylazo)anilines as gasoline dyes. J. W. Thompson and F. E. Johnson. *Industr. Engng Chem.*, 1956, **48**, 1869–73.—Alkylated aniline dyes are compared to the more common azo and anthroquinone gasoline dyes. The yellow dye [N-*sec*-butyl-*p*-(*p*-nitrophenylazo)aniline] was found to have 4½ times, and the orange dye [N,N-dibutyl-*p*-(*p*-nitrophenylazo)aniline] twice the colouring power of the older types of dye. D. B. S.

934. Effect of alkyl phenols on storage and manifold stability of gasolines. A. C. Nixon, H. B. Minor, and G. M. Calhoun. *Industr. Engng Chem.*, 1956, **48**, 1874–80.—20 alkyl phenol inhibitors were compared using a glass manifold testing apparatus. 2,6-di-*tert*-4-methylphenol appears to give the highest manifold and storage stability. The data also showed that the O.N. of a gasoline is decreased by the formation of gums by oxidn reactions. D. B. S.

935. Mechanism of antioxidant action in gasoline. C. J. Pedersen. *Industr. Engng Chem.*, 1956, **48**, 1881–4.—The antioxidant efficiencies of *p*-phenylenediamine, *p*-aminophenol, and phenol are discussed and related to their structures in order to determine the mechanism of their inhibition of the oxidn chain reaction. The following mechanisms were detected—donation of an electron to the chain carrying peroxy-free radical, donation of a hydrogen atom to the peroxy radical, and addition of a peroxy radical before or after being partially oxidized. Other mechanisms may occur which do not involve the peroxy radical. D. B. S.

936. Effect of additives on jet fuel stability and filterability. A. C. Nixon and H. B. Minor. *Industr. Engng Chem.*, 1956, **48**, 1909–16.—The effects of 250 additives (including commercial and experimental anti-oxidants, a metal de-activator, and dispersants) on the ambient and high-temp (450° F) stability of jet fuels was investigated. The specification inhibitors were found to be ineffective in prolonging storage life or decreasing the high-temp fouling tendency, probably due to the presence of diaromatics in the fuel. One of the experimental inhibitors reduced the rate of gum formation at low temp, but it only slightly improved the high-temp stability. Ambient temp filterability was improved by a trialkyl phenol inhibitor but reduced by nitrogen-containing inhibitors. Dispersants improved the ambient and high-temp filterability but not the fuel stability. The metal deactivator reduced the cat action of soluble copper and copper-bearing steels, but was ineffective against copper surfaces; it did, however, reduce the amount of high-temp deposits. D. B. S.

937. Fuel additives—problems and progress. G. Edgar and H. A. Beatty. *Industr. Engng Chem.*, 1956, **48**, 1853–7.—A review of recent developments in the uses of present-day fuel additives, including discussion of future trends and possibilities. D. B. S.

938. Some consideration on the use of to-day's fuels in automotive type diesel engines. L. A. Blanc. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 315–22.—The use of cracked dist as a diesel fuel component has grown steadily over the last few years. Provided that the requirements for Cetane No. and other physical characteristics are met, there seems to be little difficulty in getting satisfactory engine performance. Adequate lub oil and oil charge practice will allow good engine life. Stability in storage and freedom from engine filter clogging can be obtained by treatment at the refinery or by the use of additives now available. Additives are also available for improving the Cetane No. This paper discusses some lab results which support the above statements.

(Author's abstract.)

939. Some factors influencing cylinder wear in diesel engines using high viscosity fuels. C. L. Bailey and J. C. Withers. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 347–55.—In spite of the increased cyl wear which is experienced when using high-visc fuels instead of the conventional diesel oils in slow-speed diesel engines, the use of these fuels is being extended in many instances to the medium-speed engine. The increased cyl liner wear may become the limiting factor in determining the lower limit of engine size that can successfully burn high-visc fuels, since it is cyl wear which is principally responsible for reducing the gross saving in fuel cost. Some of the factors which influence cyl liner wear, and the means by which it is possible to reduce it, are studied. The effects

of various fuel characteristics are examined, and the use of fuel centrifuges, improved lub oil quality, and improved engine design features are discussed in relation to their value as means of reducing wear. (Authors' abstract.)

940. The effects of fuels and lubricants on engine performance. W. J. Sweeney, C. L. Fleming, Jr., and L. E. Moody. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 381–98.—Studies carried out at the Esso laboratories indicate that by proper selection of the fuel and lubricant it is possible, on the average, to save 5–10% of the gasoline used in existing cars. These savings are achieved by using a high O.N. fuel of balanced volatility in combination with a multi-visc grade lubricant. The lubricant is made from selected stocks and additives to reduce engine friction and combustion chamber deposits and give excellent overall performance. In addition to saving fuel in current cars, the availability of high quality balanced fuels and multi-visc grade oils should enable the automotive industry to produce the more efficient high C.R. engines they are developing sooner than would otherwise be possible. (Authors' abstract.)

GAS OIL AND FUEL OIL

941. Automatic metering for residual fuel oils. G. W. Bohn. *Fuel Oil & Oil Heat*, 1957, **16** (2), 70.—A metering device called a Voluvalve and its mode of operation are discussed. The later types of this valve incorporate a floating plunger which ensures equal pressure at the outlets of all oil passages in the Voluvalve. This ensures constant metering is obtained at all firing rates. When the valve is connected to the primary and secondary air supply dampers constant efficient smokeless combustion can be achieved at all firing rates regardless of changes in oil visc or temp. D. K.

942. Evaluating distillate fuel oil additives : stability tests. F. L. Nelson, D. P. Osterhout, and W. R. Schwindeman. *Industr. Engng Chem.*, 1956, **48**, 1892–8.—The difficulties in simulating field conditions in lab test are discussed. Lab methods are presented in which the results obtained for several commercial additives were comparable with those obtained under field conditions. D. B. S.

943. Evaluating distillate fuel oil additives : storage tests. L. H. Dimfl, J. E. Goodrich, and R. A. Stayner. *Industr. Engng Chem.*, 1956, **48**, 1885–91.—9 fuel oils and different concn of several additives were investigated using 2 separate techniques—one an accelerated ageing test in which the fuel was stirred at 140° F for 4 weeks and the other a pumping test carried out at ambient temp for several months. The optimum additive concn, at which the gum formation was reduced to a minimum, varied widely with the type of fuel oil. D. B. S.

944. Evaluating distillate fuel oil additives : field tests. R. A. Hunt, Jr., T. B. Tom, and J. A. Bolt. *Industr. Engng Chem.*, 1956, **48**, 1899–903.—The requirements of fuel oil additives and the prediction of field test performance data from bench studies are discussed. 4 evaluation tests based on static rust, interface deposit, and adherent gum and filterability after accelerated ageing were studied. D. B. S.

945. Deposits from the continuous combustion of oil fuels. A. Lewis. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 247–62.—Lab methods for investigating the formation of deposits from the continuous combustion of oil fuels are described. The effect of different operating conditions upon the quantity and nature of deposit is discussed and also the effect of composition of the ash-forming constituents in the fuel. Reaction of the deposited cpds with the collecting surface under particular conditions is shown to be related to the composition of the deposit, and possible mechanisms of attack are considered. Modification of the deposits and corrosion is shown to be possible, and suitable methods are discussed. (Author's abstract.)

LUBRICANTS

946. Hydroxyarylstearic acids as oxidation and rust inhibitors in lubricants. H. Gisser, J. Messina, and J. Snead. *Industr. Engng Chem.*, 1956, **48**, 2001–4.—Additives which combined anti-oxidizing with the rust-inhibiting properties of a long-chain fatty acid group were prepared by the condensation of aromatics with oleic acid, using aluminium chloride, sulphuric acid, and boron trifluoride as cat. Hydroxyarylstearic acids prepared from phenols using an aluminium chloride cat were the most effective as inhibitors, particularly the 9(or 10)-hydroxyphenylstearic and the 9(or 10)-methylhydroxyphenylstearic acids. The former inhibitor, when used in 2% concn with tri-*iso*-octyl phosphate and *bis*-(2-ethylhexyl) sebacate (an instrument lubricant), was still effective after 1000 hr at 100° C. Other properties are discussed. D. B. S.

947. Lubricant additives and their action. C. V. Smalheer and T. W. Mastin. *J. Inst. Petrol.*, 1956, **42** (395), 337–47.—The author is mainly concerned with detergent additives, and he explains their chemistry and mode of action. After an account of the development of hypoid gear lubricants and heavy-duty detergent oils, the author stresses the importance of full-scale tests in evaluating their performance. 2 kinds of boundary lubrication have been observed in practical tests, and the evidence suggests that some additives negate the effectiveness of others which are present in the lubricant. 43 refs and 2 pages of discussion are included. C. B.

948. Gas-engine, gas-plant lube programme. E. D. Shannon. *Oil Gas J.*, 11.2.57, **55** (6), 102.—Results are given of a gas engine test and gas plant lubrication programme carried out by Humble Oil and Refining Co. Among conclusions arrived at are that a premium detergent naphthene oil is desirable for 2- and 4-cycle gas-engine service; lead-soap E.P. gear oils are best suited for industrial application; compounded steam cyl oils should be avoided when exhaust steam is re-used; and for pump lubrication a premium industrial multipurpose grease or a premium grade rust and oxidn-inhibited oil should be used. G. A. C.

949. Evaluation of quality of lubricating oils in use. J. Solnik. *Nafta (Krakow)*, 1955, **11**, 283–4.—It has been the general practice to determine the age and suitability of oils by their sap and acid values, the limits being set at various figures in different countries. There are, however, other considerations, in particular, formation of gum and asphaltenes due to polymerization. F = (sap and acid value) − (gum content)^2 − (content of hard asphaltenes)^2. F values 0–35 indicate good oils, 36–55 oils which are satisfactory, 56–70 oils to be used in emergency only, and above 70 useless as lubricant and injurious to the engine. Estimation of F is made according to modified Suid-Pölle method, which is described. M. S.

950. Viscosity characteristics of motor oils at higher rates of shear. C. W. Georgi. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 211–21.—The customary lab methods for determining oil visc and for estimating visc from visc–temp charts are based on the premise that motor oils are Newtonian fluids, *i.e.* that their visc remain constant at any given temp regardless of the rate of shear. Unfortunately, this premise is not correct for many types of motor oil. Rate of shear may have a profound influence on oil visc, and many motor oils display non-Newtonian characteristics under certain conditions of temp and rate of shear. This study of the visc characteristics of motor oils at higher rates of shear indicates

that conventional varieties of motor oils are Newtonian fluids at moderate and high temp, although they become non-Newtonian at temp below *ca* 32° F (0° C). Motor oils which contain appreciable amounts of V.I.-improving additives are indicated to be non-Newtonian fluids throughout the temp range to which oils are normally exposed in engines. At low temp and low rates of shear, the visc of such oils tend to be materially higher than indicated by the usual lab values. At high temp and high rates of shear, the opposite condition applies. (Author's abstract.)

951. Industrial lubricants. W. A. McMillan, R. W. Hall, and B. Hegeman. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 137–45.—Greater loads, closer tolerances, and faster speeds have served to increase the demands and requirements placed on lubricants for industrial equipment. Furthermore, the lubricant today must be a multi-functioning product, capable of performing many duties other than prevention of friction and wear between moving parts. The petroleum industry has kept abreast of these developments and trends and has made available lubricants which are tailor-made to satisfy all of the needs dictated by the increased demands and expanded requirements. (Authors' abstract.)

BITUMEN, ASPHALT, AND TAR

952. Mechanical testing of asphaltic bitumen. R. N. J. Saal. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 29–46.—This paper discusses the relationship between a number of conventional mechanical tests for asphaltic bitumen and its mechanical properties. In developing a quantitative mechanical formulation for any particular application of bitumen it is necessary to consider only 2 basic properties of this material, its rheological behaviour and its tendency to fracture. Rheology is described in terms of a generalized modulus of elasticity (" stiffness "), fracture in terms of breaking strength. Both are presented in their relationship to hardness and type of the bitumen and to temp and time. Next, current routine tests, including pen, soft. pt., R. & S., flow tests, Fraass breaking temp, shatter tests, and ductility, are analysed in terms of these properties. It is shown how data obtained with these routine tests may be translated into terms of stiffness and breaking strength. The conclusion is that the first 4 tests are valuable in their relationship to these fundamental properties, but that the value of the ductility tests is very limited and that shatter tests still need further clarification.
(Author's abstract.)

953. Mechanical and rheological measurements on rubber bitumen and rubber asphalt mixtures. H. A. W. Nijveld, H. C. J. de Decker, and H. A. O. W. Geesink. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 1–9.—Various properties of rubberized bitumens are given with the intention of showing that they are different from straight-run and blown bituuens and that effects can be attained which cannot be achieved without rubber. In Pt I research on the basic properties of rubber–bitumen mixtures is described. Earlier work on the Penetration Index was extended. In addition, the Lüpke Resilience of such mixtures has been measured at temp from −45° to +60° C; the resulting resilience-temp function is a measure for the mechanical damping characteristics of the material. In Pt II data are presented concerning the properties of rubber–bitumen cpds for 2 different practical applications, where rubber seems to be of considerable importance, namely joint sealing cpds and pipe asphalts.
(Authors' abstract.)

954. The determination of oxygen-containing functional groups in blown asphaltic bitumens and similar substances. J. Knotnerus. *J. Inst. Petrol.*, 1956, **42** (396), 355–60.—The paper describes methods for the determination of organic acids, saponifiable matter, hydroxyl and carbonyl groups, it having been shown that these 4 types of cpd account for nearly all the oxygen present in blown bitumen. The methods are mostly modifications of existing ones, and are sufficiently repeatable except when applied to asphaltenes. The applicability of the methods to the determination of oxygen in asphaltenes isolated from blown bitumen is uncertain. The saponifiable matter was found, by i.r. spectroscopic analysis, to consist mainly of ester groups. 26 refs are given. C. B.

SPECIAL HYDROCARBON PRODUCTS

955. Hydrocarbon composition and viscosity-gravity constant of rubber processing oils. S. J. Kurtz, Jr., R. W. King, and J. W. Sweely. *Industr. Engng Chem.*, 1956, **48**, 2232–4.—A simple system whereby rubber processing oils of similar composition may be classified on the basis of visc-gravity constant and refractive index is described. A graph for this purpose and data for commercial rubber processing oils are given. D. B. S.

956. Choosing protection for transformer oil. L. W. Schoenig. *Allis-Chalmers Rev.*, 1956, **21** (3), 30–4.—Layout and pros and cons of various systems are discussed. Conservator (vol of expansion tank 10%, simple operation, location complications possible, contamination can be transferred); sealed tank (gas space 12½%, simple operation, oil sealed off, considerable gas space required, high operating pressure); inert-gas sealed system using N_2, 2 variants (1) pressure- and (2) oil-sealed, ((1) gas space 8%, at 5 p.s.i., oil excluded from air, some complexity and maintenance, (2) gas space + expansion tank 15%, no moving parts, no maintenance, cooling arrangements can be complicated, leak detection difficult). Usual practice is sealed tank on 10,000 kVA and less; pressure inert-gas equipment is particularly suited to large units.
V. B.

957. A laboratory study of wax processing methods. J. L. Tiedje. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 47–65.—This report discusses the effectiveness of various methods for processing petroleum waxes. Sweating, solvent de-oiling plus dist, or recrystallization from a suitable solvent may be employed to process low-boiling crystalline waxes for oil removal and m.p. fractionation. The mechanisms of these processes are discussed and a lab comparison of their effectiveness in the fractionation of a low-boiling paraffinic type crude wax is shown. It is concluded that solvent recrystallization is the most efficient of these processes for m.p. separation. Recrystallization is also the only one of the above processes effective in separating high-boiling microcrystalline waxes according to m.p., and is therefore the only one applicable to all types of petroleum wax. A combination of dist and fractional crystallization will permit complete separation of wax types. A simple classification of waxes according to m.p. and visc is shown to be adequate to define waxes of widely varying chemical structure and physical properties.
(Author's abstract.)

958. Development problems of chemical concerns supplying detergent alkylate. J. C. Kirk and E. R. Baker. *Soap, N.Y.*, 1957, **33** (2), 51.—This review is confined to the alkyl benzene types of intermediate, and in particular to those derived from propylene polymers. D. K.

DERIVED CHEMICAL PRODUCTS

959. Automotive antifreezes. J. J. Ondrejcin. *Soap, N.Y.*, 1957, **33** (2), 91.—The reason for the selection of certain chemicals as antifreeze bases, some problems of formulation,

and the reasons for some of the modern automotive cooling system practices and recommendations are subjects discussed. D. K.

960. Shell. A comprehensive complex. Anon. *Mfg Chem.*, 1957, **28** (2), 62.—Brief review of Shell's work to date in Britain on detergents, ethylene oxide, solvents, plastics, and agricultural chemicals. D. K.

961. ICI—intermediates for special products. Anon. *Mfg Chem.*, 1957, **28** (2), 65.—The part ICI plays in providing chemicals from petroleum is discussed. D. K.

962. Making chemicals from petroleum. H. L. Bennister. *Mfg Chem.*, 1957, **28** (2), 54.—The production of raw materials from crude petroleum and their utilization for the production of various chemicals is described. 19 literature refs. D. K.

963. Petrochemical facts and fancies. C. Bost. *Bull. Assoc. franç. Tech. Pétrole*, 1957, 3–26.—16 French companies operate petroleum chemical plants (map) yielding 300,000 tons/year products (excluding 8). Main product categories (hydrocarbons, base chemicals, high polymers, additives) are listed and discussed. Rapid growth of French petroleum chemical industry forecast, doubling by 1959 and attaining a foreseeable max of 3 million tons/year by 2000, of which 75% will be reached by 1975. V. B.

COAL, SHALE, AND PEAT

964. Pyrolysis of oil shale. L. di Ricco and P. L. Barrick. *Industr. Engng Chem.*, 1956, **48**, 1316–19.—The pyrolysis of oil shale under reduced pressures was investigated in a fluidized solids system at 250°–465° C. The rate of pyrolysis corresponded to a first-order reaction and was found to be independent of pressure between 625 and 50 mm of mercury over the temp range investigated. The results agree well with other authors at the higher temp, but at the lower temp larger values of K are reported. D. B. S.

965. Developments in lignite technology and utilization. R. McMurtrie and W. H. Oppelt. *Industr. Engng Chem.*, 1956, **48**, 1996–2000.—The possibilities of gasifying and hydrogenating lignite to liq fuels or bulk chemicals receive attention. D. B. S.

MISCELLANEOUS PRODUCTS

966. The manufacture of synthetic graphite. (In German.) J. Breidenfeld. *Elektrotech. Z.*, 1957, **9** (2B), 47–9.—Details are given of the production of synthetic electrical graphite from a number of materials, including petroleum coke. P. J. K.

967. Carboxylic rubbers from scrap vulcanized rubber. J. Green and E. F. Sverdrup. *Industr. Engng Chem.*, 1956, **48**, 2138–44.—Scrap vulcanized rubbers may be treated with unsaturated acids to form carboxylated elastomers. The mechanism of this reaction is discussed. The properties of this type of rubber were found to depend on the amount and type of carboxylating agent used and on the properties of the original scrap, but in many cases the elastomers possessed higher oil resistance, higher modulus, improved ageing, and lower benzene extract than the original. Various curing techniques using zinc oxide, amines, and diethylene glycol, and also blending with neoprene are fully discussed. D. B. S.

968. Reinforcement of synthetic elastomers. Various. *Industr. Engng Chem.*, 1956, **48**, 2080–94.—3 papers in which the effects of particle size and other properties of mica and carbon black fillers on the tensile behaviour of butyl and GR-S rubbers are discussed. Mica was found to have 30% of the reinforcing effect of carbon black, but it improved the elongation without sacrifice in breaking strength. The effect of type and concn of carbon filler used in rubber adhesives for the bonding of brass plates was also studied. D. B. S.

CORROSION

969. Prevention of corrosion in packaging and storage. Practical methods of preventing corrosion in packages. J. J. Ferriggi. *Chem. & Ind.*, 1957, 280–7.—A comprehensive review of the treatment of packaging problems, beginning with consideration of the risks involved in handling, transport, and storage under various climatic conditions. Before corrosion preventives can be applied, articles must be cleaned and dried; various types of cleaning agent and methods of application and subsequent drying procedures are described. Selection of temporary corrosion preventives is discussed; these include films of resin, lanolin, petrolatum, grease, inhibited mineral oils, and strippable plastic, also vapour phase inhibitors. Their characteristics and methods of application are described. Protected articles are then enclosed in inner packaging, *e.g.* grease-resisting paper or waterproof carton, together with desiccant to avoid condensation; a formula is given for the amount of desiccant required. Finally, outer packages are considered; suitable designs for wooden crates and cases are illustrated. It is important that the outer container should have a strong waterproof lining. W. A. M.

970. Prevention of corrosion in packaging and storage. Selection of the packaging method. F. A. Paine. *Chem. & Ind.*, 1957, 288–91.—Basically, corrosion is prevented by excluding moisture; selection of the method of protection is made by a process of elimination (example given). The importance of correctly specifying hygroscopic packing materials, such as paper-board, wood, etc., which may contain corrosive materials, is stressed. Accelerated testing procedures can give useful information. W. A. M.

971. Corrosion in sulphur recovery plants. J. W. Kilmer, M. H. Rahmes, and H. L. Lawler. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 66–9.—Major corrosion encountered in 3 sulphur recovery plants which have been in operation from 3 to about 6 years has resulted where free water was present in process streams containing corrosive components. Corrective measures are to insulate or to redesign equipment so that metal temp do not reach the water dew point or otherwise eliminate liq water in which corrosive components can dissolve. (Authors' abstract.)

972. Cathodic protection in gasoline plant process equipment. M. J. Olive. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 62–5.—By adding a new wrinkle to an old theory of corrosion mitigation—combining cathodic protection with water treatment—Arkansas Fuel Oil Corpn has succeeded in almost eliminating water-side corrosion problems at its Greggton, Texas, plant. (Author's abstract.)

973. The "ifs" and "ands" of gasoline plant corrosion surveys. O. L. Gambrell. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 57–62.—In recent years the petroleum industry has devoted a tremendous amount of individual and co-operative study to the problem of corrosion and its mitigation. Corrosion is not necessarily a new problem to the industry, but the mitigation of corrosion has become increasingly important. The discovery of sour oil and gas and the ampli-

fication of product sales competition are only two reasons for the increased interest in corrosion mitigation. That segment of the industry which probably experienced the greatest degree of corroding facilities was given preferential consideration in these studies. Satisfactory determination of the causes of corrosion, proper analysis of these causes, and economical control methods have resulted for gas condensate wells and petroleum transmission pipelines. The same cannot be said for plants and facilities which process gas for cycling, resale, and/or removal of liq hydrocarbons, acid gases, and water. The paper briefly describes the methods available for determining the type, location, and degree of corrosion and presents a suggested general procedure for conducting a programme to determine the condition of facilities comprising a compression-absorption type natural gasoline plant. (Author's summary.)

974. Protection of oil tanker cargo tanks. Success of modern anti-corrosion treatment. Anon. *Corrosion Tech.*, 1957, **4** (1), 15–16.—Epikote resins are proving effective in arresting corrosion, with economical results. Tests—commenced in 1953—are still in progress on m.v. *Pendrecht* a 20,000-ton tanker. Epikote treatment following sand- or shot-blasting on an 18,000-ton general-purpose tanker—*ca* 41,000 m² inner surface—would cost approx £50,000. A calculation based on the cost of tank replacements alone shows that the Epikote-resin-based system on shot-blasted areas of *Pendrecht* has paid for itself already; the paint is still intact. R. T.

975. Corrosion of distillation unit. S. Gibinski. *Nafta (Krakow)*, 1955, **11**, 282–3.—Corrosion effects are divided into "cold" (*i.e.* below 250° C) and "hot." One is due to HCl and H_2S and the other to naphthenic, sulphonic, and perhaps anhydrides of inorganic acids. The first variety can be prevented by use of stainless steels, whilst the "hot" corrosion can be also overcome by centrifuging the crude or by injection of alkali. Here it has been shown that NH_3 is less efficient than Na_2CO_3. M. S.

ENGINES AND AUTOMOTIVE EQUIPMENT

976. What's happening to automotive engines? D. F. Caris, A. D. McDuffie, B. J. Mitchell, and F. A. Wyczalek. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 399–436.—Improving the efficiency of automobile engines is one of the most important objectives of automotive engineers. Higher C.R., the key to efficiency, can be achieved by the use of higher octane fuel and from the development of mechanical O.N. Such factors as ignition control, valve timing, carburetion, engine-transmission relationship, and combustion chamber design contribute to the development of mechanical O.N. Of these factors, combustion chamber design offers the most fruitful field for future development. By careful co-ordination of 3 major parameters, flame travel, turbulence, and mass distribution of the charge in favour of shower combustion time, it is possible to make a substantial improvement in the octane requirement of automotive engines.

(Authors' abstract.)

977. The prevention of oil-ash deposition by means of fuel additives. P. T. Sulzer. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 223–46.—Some methods, which differ fundamentally from one another, for preventing oil-ash deposits and corrosion in gas turbines are described with reference to test rig investigations. It is shown that the mixing of fuel additives is particularly successful. The addition of aluminium silicates gave the best results of all the 15 additives cited. Full-scale tests, lasting over 2000 hr, with specially-prepared heavy oil, on a semi-closed cycle, 20,000 kW gas turbine installation gave satisfactory results, even under extreme conditions. (Author's abstract.)

978. Nine gas turbines aid oil production. Anon. *Gas Oil Pwr*, 1957, **52**, 23.—A short account of 9 gas turbine generating sets for oilfield power stations in Venezuela, Colombia, and Borneo. The turbines burn natural gas and the plants need little cooling water. H. C. E.

SAFETY PRECAUTIONS

979. Safety and hygiene in refineries. K. Minski. *Nafta (Krakow)*, 1955, **11**, 284–6.—During the last 4 years Zl 4115 million (£140 million) has been spent on hygiene and safety at work. During that period accidents fell by 37%, in spite of an influx of new inexperienced labour. A decree governs these matters, and it includes the refining industry. Here the absence of a man through injury may mean breaking up of a team. Polish IP produced a report comprising 3 parts: analysis of accidents, rules for accident prevention, and list of equipment. M. S.

980. Faster tank fire fighting. Anon. *Petrol. Process.*, 1956, **11** (12), 51.—Shell Oil Co have developed a new technique giving faster action in the instance of tank fires. Each tank is equipped with a plastic puncture plate stretched over a rectangular flange at the opening of the tank roof. In the advent of fire a portable foam tower equipped with a hook is moved into position. The tower is lowered to allow the hook to puncture the plate and foam is admitted. J. H.

981. Fire research in Great Britain. S. H. Clarke. *Nature, Lond.*, 1957, **179**, 287–9.—Among the work carried out at the Fire Testing Station is the study of initiation and growth of fire, and of protection against the hazards of fire and explosion with flammable gases, vapours, and dusts. H. C. E.

982. Fire protection in the chemical industry. Various. *Mfg Chem.*, 1957, **28** (3), 109–23.—4 articles on fire fighting are presented: (1) Basic Principles, by N. C. Stother Smith; (2) Chemical Fire Fighting, by J. D. Shapland; this article discusses fighting chemical fires and the use of chemicals for this purpose; (3) Manufacture and Properties of Carbon Tetrachloride and Chlorobromomethane, by J. O. Grice; (4) Fire Fighting Equipment Guide. D. K.

983. Synthetic fluids for transformer cooling. I. Properties of "Pyroclor." P. D. Wilmot and N. G. H. Thomas. *Engineer, Lond.*, 1957, **203**, 410–12.—Most important of fire-resistant transformer fluids ("askarels") is a blend ("Pyranol," "Inerteen") of 60% hexachlorodiphenyl, 40% trichlorobenzene, marketed as "Pyroclor" in the U.K. by Monsanto. Blend proportions are selected so as to give a visc–temp curve similar to that of transformer oil. Elec, phys, and chem properties of "Pyroclor" are given in detail, IP tests being used in some cases (*cf.* Abs. **219**, 1954).

II. Design and application of "Pyroclor"-filled transformers. *Ibid.*, 451–2. V. B.

MISCELLANEOUS

984. United Kingdom fuel and power. H. F. Haber. *J. Inst. Fuel*, 1957, **30** (193), 65.—The past and present supplies of coal, gas, electricity, and fuel oil are reviewed, together with future requirements. The contribution to be made by oil and atomic energy is also considered. Changes in the pattern of consumption, *e.g.* the gradual shift from coal to gas and electricity, and some of the economic problems of the fuel and power industries are discussed. The situation of the U.K. is compared with that in other countries. 40 refs and 6 pages of discussion. D. K.

985. U.K. petroleum trade in 1956. Anon. *Inst. Petrol. Rev.*, 1957, **11** (123), 78.—Tables show quantity and value of U.K. petroleum products, percentage imports and average C.I.F. unit values to the U.K., countries importing, and U.K. exports of home-produced and home-manufactured petroleum. G. A. C.

986. Power and national prosperity. A. Parker. *J. Inst. Fuel*, 1957, **30** (193), 84.—The Mitchell Memorial Lecture read on 16 Oct 1956 at Stoke-on-Trent. A survey of the energy resources and an estimate of probable changes in demand in the U.K. and other parts of the world is made in order to assess future needs and prospects. Information on annual income and standard of living in relation to fuel and energy consumption, and expenditure on fuel and power in the U.K. in relation to the national income is discussed. D. K.

987. Conference on the efficient use of fuel in industry. Various. *J. Inst. Fuel*, 1957, **30** (193), 91.—This conference was held at Olympia, London, during the course of the Fuel Efficiency Exhibition, Oct 1956. Summaries of the papers and discussion which followed are presented. The papers were: The Efficient Use of Coal, by F. B. Karthauser; The Efficient Use of Coal, by R. Nichol; The Efficient Use of Oil, by G. Richardson and A. B. Pritchard; The Efficient Use of Gas, by A. E. Tyrrell; The Efficient Use of Electricity, by J. I. Bernard; Heat and Power Surveys, by L. Clegg; Waste Heat Recovery, by G. N. Critchley; The Clean Air Bill and Industry, by W. J. Dickie; The Clean Air Bill and Industry, by W. B. Kennedy. D. K.

988. The Middle East—unlimited economic frontier. Anon. *Oil Forum*, 1956, **10**, 466–8.—This paper was written before the Suez crisis, and damage to the Middle East pipelines. Economic development in the Middle East is based on the oil industry. Proved petroleum deposits amount to 72·5% of the known Free World deposits, as shown graphically. Plans have been laid for the oilfields to meet W. European and Asian demands. The export market for equipment—already considerable—will continue to increase with rising production. The operating oil companies build entire towns with all necessary facilities, and act as purchasing agents for a wide variety of materials. Relevant data are tabulated. R. T.

989. Giant Texas. Anon. *Petrol. Press Serv.*, 1957, **24**, 95–7.—The hesitation of Texas to fulfil its role in aiding W. Europe during the Suez crisis has drawn attention to this biggest oil area in the Western Hemisphere. Attention has been focused on the position and powers of the Texas Railroad Commission, by which oil production is controlled and allocated. First steps were taken in 1930 to prorate oil, and a system—much as it exists today—has been in effect since 1932, when the Market Demand Law was passed by the Texas Legislature. Under the Commission's policy, drilling in Texas has trebled since the war to over 21,000 wells. In 1901 the Spindletop discovery started the modern era with a gusher of over 75,000 b.d. Production in 1956 was 1101 million brl of oil = 150 metric tons, and *ca* 170 million brl of natural gas liq; by comparison the whole Middle East produced 172 million tons of crude oil. Petroleum chemical production along the Gulf Coast has become the biggest manufacturing industry. *Ca* ¼ of the state's total revenues are from oil and gas taxation. Texas education reaps big returns from the oil and gas industry. For a long time Texas may count on its oil and natural gas as the basis of its prosperity, but probably it has reached or approached its peak. R. T.

990. Progress in development of the energy resources of Canada. Water Resources Branch, Dept. of Northern Affairs and Natural Resources and Dominion Coal Board. *Engng J., Montreal*, 1956, **39** (12), 1678.—Water power—one of Canada's great national resources—is responsible for rapid industrial development. During the 6-year period 1949–54 inclusive, developed capacity increased by 4,146,500 kW, being in 1954 50% > in 1948. Decline in railway and household coal requirements is shown, but use of sub-bituminous and lignite coals has increased. In 1950 consumption of petroleum and petroleum fuel products was approx 21,268,000 Kl, native production was 4,629,000 Kl = 22%. In 1954 consumption was 33,458,000 Kl, a rise of 63%; Canadian production was 15,392,000 Kl crude. Total oil requirement originating in Canadian wells rose from 22 to 46%. Discoveries of major oilfields in the Prairie regions of W. Canada are the basis of an expanding exploration programme. Available reserves—petroleum or lighter natural gas liq—were estimated on 31 Dec 1950, at 191,000,000 Kl, on 31 Dec 1954, at 385,000,000 Kl. Natural gas development has been concurrent with that for petroleum. Production over the 5 years to 1954 has almost doubled. Reserves have increased from 153×10^{14} m³ in 1946 to 612×10^{14} m³ in 1954. The major problem is a remunerative outlet. Pipelines are projected to serve the Pacific Coast in Canada, and the U.S.A. Wood is of little importance industrially. Atomic energy is receiving consideration. A forecast of Canadian energy requirements is tabulated, and future needs are discussed on the basis of population. R. T.

991. Ten years of oil have changed the face of Canada. M. S. Beringer. *Oil Forum*, 1956, **10**, 31–2.—Canada's emergence as an important crude oil producer dates from Feb 1947, when Leduc No. 1 well in Alberta started the new era. In the period since Leduc total investment in the oil industry = $3000 million. In 1946 annual consumption of petroleum products was 6·6 brl/year/person. Canadian production was 20,841 b.d. = approx 9% of domestic consumption. Since 1946 consumption is over 15 brl/year/person; total requirement = 635,000 b.d. Canadian production meets 62% of the nation's needs, or 432,000 b.d. Canada's crude and natural gas liq reserves have increased from 72 million brl in 1946 to 3000 million brl. In 1955 there were 7400 producing wells in Canada. Daily throughput capacity of refineries has increased from 245,865 b.d. in 1946 to 650,000 b.d. Pipeline mileage in Canada has increased to approx 5049 miles, tenfold the 1946 figure. Canada's energy requirements have increased in 25 years from 12 million B.t.u. to 2640 million B.t.u. = over 120%. In this period energy from liq petroleum rose from 19 to 49%; use of natural gas doubled from 3 to 6%. Estimates are given in relation to increase in population in the next decade. The petroleum chemical industry has grown phenomenally, and at present represents an investment of > $500 million. R. T.

992. Canadian vista. Anon. *Petrol. Press Serv.*, 1957, **24**, 86–90.—Since the Leduc discovery in 1947 the oil industry has become a major factor in Canada's industrial growth and

—with present output over 0·5 million b.d., and productive capacity 1 million b.d. increasingly important for the international oil trade. The 718-mile Trans-Mountain pipeline—completed in 1953—connects Edmonton westward with Vancouver; the Interprovincial line—completed in 1950—connects Edmonton eastward with Sarnia. This major 2500-mile trunk line increased the supply pace and vol of growth sharply. Canada's domestic oil consumption jumped from 274,000 b.d. in 1947 to *ca* 700,000 b.d. in 1956. Refining capacity 250,000 b.d. in early 1947 has now passed 700,000 b.d. Cracking and reforming capacity approach 350,000 b.d. Total present investment in the petroleum chemical industry is *ca* $350 million. The immediate impact of the Interprovincial pipeline was to bring Ontario refineries within reach of W. Canadian production. Notable developments in 1953 were discovery and development of the billion-brl Pembina field in Alberta, and discovery of major light crude reserves in SE. Saskatchewan. Further pipelines in hand will increase markets. Increase of Trans-Mountain exports beyond 250,000 b.d. will depend primarily on competition in California with imported Middle and Far East, and U.S. Rocky Mountain states crudes. Supplies to Montreal are in competition with Venezuelan and Middle East crudes. Gas will be exported to the U.S. Pacific NW. Industries have relied heavily on U.S. capital. R. T.

993. Brazil's hunger for energy. Anon. *Petrol. Press Serv.*, 1957, **24**, 15–17.—Stimulated by increasing foreign investment, industrialization in Brazil is progressing rapidly. Restrictions on imports are encouraging foreign firms to build factories. Problems to surmount in the rather unsure economic improvement are continued inflation and the need for commercial energy for growing industries and for power and light for the cities. The output of hydro-electric potential—though high—is inadequate for Brazil's needs, and more reliance is placed on petroleum imports. Consumption of oil in 1956 reached *ca* 9·4 million tons, chiefly imported. Imports of crude oil and refined products cost the equivalent of *ca* U.S. $250 million, or over 20% of the total imports bill. Petrobras, the state oil concern, has increased the local production rate to 1 million tons p.a. The emphasis of the 5-year development plan (1956–60) is on increasing energy supplies—hydro-electric and petroleum sources—aided by further U.S. loans. Foreign risk capital is excluded from direct participation in the oil search, but Petrobras' resources are inadequate for the vast exploration effort required. R. T.

994. Aspects of German expansion. Anon. *Petrol. Press Serv.*, 1957, **24**, 3–6.—W. German economy is less seriously affected by the Suez crisis, because her oil consumption—although rising rapidly—accounts for only *ca* 10% of the total energy demand. The position is more favourable than in other OEEC countries—Austria excepted—in that ½ of her oil consumption is covered from indigenous crude and coal oil. Crude oil imports before the Suez Canal blocking—*ca* 8 million tons p.a.—including 2 million tons of Saudi Arabian crude via Tapline, and *ca* 1 million tons from Venezuela and Mexico, will be affected only by tanker shortage. The gap between coal supply and demand is destined to widen in future years. The growing supply gap will be filled chiefly by larger imports of oil, mainly crude, and an increasing indigenous production of crude oil and natural gas. Inland consumption of petroleum products has more than doubled in the past 5 years, reaching *ca* 11 million tons p.a. in Jan–June 1956. Overall consumption is expected to rise to 23·5 million tons in 1961 and to over 30 million tons in 1965. Projects for refining industry expansion may bring the total capacity to 25 million tons by the end of 1961, possibly to 30 million tons in the middle 1960s. R. T.

995. The position of the chemical industry in Ecuador. (In German.) R. Staufer. *Chem. Z.*, 1957, **81** (4), 99–102.—A general review of the chemical industry in Ecuador contains some details of the petroleum industry. P. J. K.

996. What is the position of the chemical industry in the Eastern bloc? (In German.) E. Saalmann. *Chem. Ind.*, 1957, **9**, 47–60.—A general review of the chemical industry in in the Soviet bloc, containing some details of the petroleum industry. Known oil reserves in the Eastern bloc rose from 6·6 to 10·9% of the world reserves during 1956, the greatest part of these being in China. Oil production in Russia rose from 71 million to 84 million tons in 1956; 97 million tons are expected in 1957 and 135 million tons by 1960. A few details are also given of the petroleum chemical industry. P. J. K.

997. Development of refining industry in six-year plan and its prospects in the next five-year plan. L. Zurkowski. *Nafta (Krakow)*, 1955, **11**, 252–5.—Refining is becoming an ever-increasing section of the Polish oil industry. At the end of the 6-year plan this summary is presented: refining throughput rose by 173% instead of 115% as planned; of this, selective refining rose by 300%, instead of 700% and tower dist by 226%, instead of 204%. Productivity rose by 152% instead of 128% and refining capacity exceeded planned expansion by 26%. Highly refined lubricants increase the value of products obtained. Investment was 25% lower than planned. For the next 5 years consumption is expected to double and keep rising so that new refineries are a necessity. Old refineries must raise their capacity by 35% by 1960, but even so some of the fractions cannot be refined, but only used as fuel. Cracking and vis-breaking, selective refining, dewaxing, and bitumen blowing are all on the list, together with improved ancillary equipment. Unfortunately there is no hope of an adequate supply of domestic crude. For 1960 it is planned that yearly refining will rise by 110% over 1955, whilst losses should fall by 29%. Tower dist will rise by 490%, whilst batch dist will be equal to only 16% of the total. Selective refining will rise by 112%. Production of petrol (benzine) will rise by 190% and of oils by an average of *ca* 50%. Efficiency per man should go up by 35%.

In spite of all that and of the planned building of a sixth and seventh refinery of capacities 1 and 2 million tons, due to the tremendous rise in consumption only 46% of it will be satisfied by products from Polish refineries. This estimate relates to 1963, and the figures for the future are likely to be still worse. By refining in Poland and importing the crude only, costs would be halved. In the absence of indigenous supplies, long-term purchase agreements will be of immense value to planners and designers. M. S.

998. Petroleum Division of the American Chemical Society. Anon. *Petrol. Times*, 1.2.57, **61** (1552), 116.—Abstracts are given of 32 papers presented at Atlantic City, N.J., Sept 1956, and include sweetening of inhibited gasoline, a mechanism of acid catalysis, hydrocarbon ions in the gas phase, determination of trace amounts of chlorine in naphtha, explosive limits of cumene, and irradiation of petroleum hydrocarbons. G. A. C.

999. Inventiveness in refining industry. Anon. *Nafta (Krakow)*, 1955, **11**, 271–2.—5 inventions are listed: (1) improvement in refining of lub oils to high grade requirements; (2) improvement in regenerating lub oils to contain less than 0·2% foreign matter; (3) steam heating of dist to yield petrol (benzine); (4) tube cleaners for pipe-stills; (5) tube cleaners for heat exchangers (both without dismantling). M. S.

1000. Petroleum industry's greatest growth potential lies in free foreign world. Anon. *Oil Forum*, 1956, **10**, 460–1.—America's petroleum requirements are expected to rise from

the present 9 million b.d. to 12,925,000 b.d. in 1965. Foreign Free World demands are expected to rise from the present 6,250,000 to 12 million b.d. in 1965. Less reliance is placed on the U.S.A. for crude oil and refined products. World oil movements—pictured on a flow map—show that the U.S.A., even the Western Hemisphere as a whole, is no longer the dominating factor in oil export markets. The rise in relative importance of overseas oilfield and refining operations is synonymous with increased significance as a market for equipment and services. Domestic sales from 1950 to 1955 increased by 59% export sales by 118%. R. T.

1001. The *Oil Forum* story. Anon. *Oil Forum*, 1956, **10**, 405–12.—An extensive record of this journal's unique service to the petroleum industry. Part of the story has been told before in fragmentary form. Most of the events—international in character—have not been described previously. R. T.

1002. Ten years of refining progress. V. A. Kalichevsky. *Oil Forum*, 1956, **10**, 416–21.—A review of the spectacular progress in the petroleum refining industry. A well-balanced refinery, particularly one connected with petroleum chemical plants, has no waste, and is capable of turning every drop of oil into profit. Assuming that confiscatory taxation does not impede industrial progress, the next decade should bring new developments in the petroleum refining industry. It may be assumed that a petroleum refinery will become indistinguishable from a chem plant, automatically controlled, with specialized supervision. R. T.

1003. The independent refiner can make it. R. L. Tollett. *Oil Forum*, 1956, **10**, 422–4.—Refinery operations must be planned with regard to present and prospective markets. This involves intelligent use of plant—retention or modification for economical development. Many small independent refineries have closed down in the last decade, others have progressed through revamping existing equipment, adding storage and new processing equipment. This healthy growth—profitable to employees and owners alike—will probably endure for at least another decade. R. T.

1004. Battling for scientific manpower. J. R. Tusson. *Oil Forum*, 1956, **10**, 429–30.—Serious scientific manpower shortage in the U.S.A. is discussed. The force of science—a new factor—governs every move, even destiny. The American system for producing scientists is voluntary, the Russian by mass production. Scientists are a vital new element in overcoming the old system of reliance on capital, labour, and the Government. By 1965 the U.S.A. will have 4 times as many chemical industries as are now in operation. The Louisiana Section of the American Chemical Society tries a new approach to the problem of implementing voluntary education. R. T.

1005. How to plan and control capital expenditures. G. E. Kiser. *Pipe Line Ind.*, 1956, **5** (3), 66–74.—Successful completion of a pipeline project—a new station or a pipeline loop—depends on planning and control of capital expenditures. Methods adopted by 15 oil companies are presented. R. T.

1006. Where'll to-morrow's energy come from? W. C. Schroeder, F. L. Hartley, and C. S. Brinegar. *Oil Gas J.*, 25.2.57, **55** (8), 120.—The contributions of oil, oil shale, coal, bituminous sand, and nuclear power to the estimated total future energy demand are discussed. G. A. C.

1007. Review of materials of construction in chemical engineering. Various. *Industr. Engng Chem.*, 1956, **48**, 1695–801.—A review of recent developments in materials of construction used for chemical engineering plant. Materials covered include aluminium alloys, ceramics, elastomers, fibres, lead and lead alloys, less common metals, nickel and high nickel alloys, plastics, stainless steel, tin and its alloys, titanium, and wood. Numerous refs are included. D. B. S.

1008. Review of unit processes in chemical engineering. Various. *Industr. Engng Chem.*, 1956, **48**, 1551–694.—A very comprehensive review of the latest developments in the following unit processes: alkylation, amination by reduction, esterification, fermentation, Friedel–Crafts reactions, halogenation, hydration and hydrolysis, hydrogenation and hydrogenolysis, polymerization, pyrolytic and cat decomposition of hydrocarbons, pyrolysis of coal and shale, and sulphonation and sulphation. Refs are numerous. D. B. S.

1009. Fire at Shell Haven refinery, Essex. W. H. J. Benton. *Inst. Fire Engrs Quart.*, 1957, **17** (25), 19–24.—Details of the methods used in extinguishing a fire which involved a tank containing *ca* 2000 tons of platformate on 24 Sept 1956. The tank was damaged by explosion and heat, and *ca* 175 tons of the oil were destroyed. The rest was partly transferred during the operation and partly remained in the tank after the fire was extinguished. G. S.

1010. Soil conservation pays along right-of-way. R. Hoyt. *Pipe Line Ind.*, 1956, **5** (3), 46–8.—The most effective way for a pipeline company to ensure a stable, permanent cover over its lines is to encourage sound farming practices to hold the soil in place. The number of companies doing this by a greater degree of co-operation with landowners and the Soil Conservation Service is described. The planned programme prevented a single case of damage in a major flood in Iowa, which involved 700 bridges and culverts on main highways and 2000 on secondary roads. R. T.

1011. Ultrasonics speed inspection of piping, tanks, and engines. D. J. Evans. *Pipe Line Ind.*, 1956, **5** (3), 52–5.—Modern ultrasonic inspection techniques can cut the cost of older conventional methods to $<15\%$. An important application of the method is that of measuring the thickness of steel plates, where only one side is accessible, *e.g.* fuel storage tanks. Other applications are to corrosion rate and pitting. Successful surveys reported are on pipeline river crossings—in one case exposed pipe—and on the bottom plates of a 100,000-brl oil storage tank. Other applications are described. Visible indication equipment is the best for station tests. Results obtained are within $\pm 1\%$ of metal thickness. R. T.

1012. Line "walking" by helicopter. Anon. *Pipe Line Ind.*, 1956, **5** (3), 56–7.—Hope Natural Gas Co's helicopter inspection crews completed 9420 miles of right-of-way inspection in 217 hr 25 min flying time. R. T.

1013. Current news. Anon. *Nafta* (*Krakow*), 1955, **11**, 224.—Figures for Aug 1955 show that crude oil production was $+2{\cdot}4\%$, natural gas production $+3{\cdot}7\%$, gasoline production $+5{\cdot}3\%$, drilling $+16{\cdot}2\%$; all these values envisaged in plan. On 2 Sept 1955 the machine and equipment factory at Glinik completed its production planned for 1949–55.

Report on the Conference of Association of Engineers and Technicians (Krosno, 1.7.55) on rotary drilling, which passed a resolution stating that unless best steels are used in production of bits and investigations into best methods of drilling are carried out and published without delay the imperative opening-up of N. oil-bearing areas will be considerably hampered.

First issue of *Petroleum Review* has appeared.

Northern Regional Drilling Office has been opened in Poznan. M. S.

BOOK REVIEWS

The Empire of Oil. Harvey O'Connor. London: John Calder, 1956. Pp. xii + 372. 25*s*.

Mr O'Connor's understanding of the international petroleum industry appears superficial and certainly partisan. He dislikes the bigness of integrated oil companies, especially " the members of that exclusive club, the world oil cartel " and he gleefully accepts much of the tendentious matter of the " International Petroleum Cartel Staff Report to the Federal Trade Commission " Aug 1952, to support his arguments. His assessment of the Middle East is lurid :

> "Over the entire region along the Persian Gulf from Iran to Qatar, hangs a leaden curtain of suspicion, fear, and hatred. . . . Instability is inherent in all these synthetic regimes. Overlain on instability are flaming hatreds, hatreds of the British for their domination, growing hatred of the United States as an accomplice, hatred of Israel as an intruder in Arab lands and expeller of nearly a million refugees, hatred of Communism on religious grounds as well as political grounds. Under this powder keg there lies oil worth a hundred billion dollars. All this is owned by hated foreigners who hope, at the current rates of profit to pocket some $25 billion from the Middle East. As a price for relative stability these companies are willing to pay an equal sum to their local political caretakers. . . . The U.S.–British companies are following the only policy tenable—to make as much as possible as quickly as possible before they are engulfed in the deluge."

However, now turn to the Western Hemisphere, where

> " in the free world straddled by the international oil cartel, the small but steady light of Petroleos Mexicanos shines as a beacon of hope for the oil-rich but poverty-stricken lands of Latin-America and the Middle East. . . . To other countries Pemex is proof that there is an alternative to domination by Standard, Shell, and Anglo-Iranian."

Workers of the World, unite. You have nothing to lose but your chains!

The U.S. domestic scene is portrayed in bleak black and white.

> " A score or so of major companies dominate the domestic market from well to service station. Under the majors and behind them is the legion of those who stand to profit from the private exploitation of the greatest natural resource. This legion is topped by the millionaire wildcatters of Texas, the plungers in the feverish hunt for new sources of crude, the men who can hardly lose, thanks to the peculiar federal tax structure known as ' depletion allowance.' Flushed with millions they have done nothing to earn, these speculators reach out for financial and political domination of the country."

These extracts are typical of the presentation of the subject. The publishers, in their foreword, state that they know a first-rate piece of work when they see it. " The Empire of Oil, based on extensive first-hand knowledge and intensive research, is a masterpiece of condensation and exposition."

A further selection of the choicer gems studding this masterpiece are given below, after a perusal of which the potential reader may be forgiven if he feels that his leisure could be spent to better advantage.

> " Everywhere it (oil) has been hunted as a wild animal and the law of the jungle has entered into the heart and sinew of the industry. The sordid and bloody story has been told in local and world wars, in revolutions and corruption, in continuing world turmoil."

> " The purpose of conservation is to limit production to that which assures the greatest profit to the biggest corporations."

> " Given persistence and a minimum amount of sense, the well-heeled wildcatter is bound to win. It's simply a matter of drilling enough holes to beat the 8 to 1 odds. It's not a game for the little fellow, to be sure, but the biggest windfall of the century for the man about to come across to Uncle Sam in the 80 percent and up brackets. . . . What is still a gamble to the outsider who stands to win only through grace of federal tax laws is a sure thing to the major oil companies. Armed with the best geophysical information and hundreds of millions of dollars for exploration, they reap the bulk of their profits from exactly this kind of venture. Production is their big money maker and depletion allowance the key to it."

Finally, Mr O'Connor's panacea for the industry is international control under a U.N. Oil Authority, to take over the administration of the Middle East oil deposits to provide equal access to all nations and all buyers. However, such a scheme has already received an adverse vote in the U.N. Economic and Social Council on 12 Aug 1947.

J. B. K.

Statistical Summary of the Mineral Industry. Production, Exports, and Imports, 1950–1955. Colonial Geological Surveys. London: HMSO, 1957. Pp. 369. 27*s*. 6*d*. net.

A complete reference work to the production and trade in all the world's important minerals and metals over the six-year period 1950–55. For example, under " Petroleum and Allied Products," the production figures cover crude petroleum, natural gasoline, natural gas, asphalt rock, natural asphalt, and oil shale. Output of refinery products for a large number of countries is tabulated, as also are details of exports and net imports of petroleum and allied products. Similar data are given for the other minerals and metals.

Analysis of Air near Heavy Traffic Arteries. N. A. Renzetti. Air Pollution Foundation No. 16. Los Angeles, California: Air Pollution Foundation, 1956. Pp. 28. $1.50.

With the object of ascertaining the concentration range of the main constituents of automobile exhaust in the vicinity of heavy traffic, samples were taken over a four-week period in Sept 1956 in the Los Angeles area. They were collected at 5 ft above ground level and within 60–75 ft of the traffic artery. Analyses gave the following results: CO, 4–93 p.p.m. by vol; hydrocarbons (as hexane, 0·25–2·3 p.p.m. by vol; CO_2, 0·05–0·14% by vol). Full data are tabulated.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

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*020 World Petroleum Congress. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings Section 1. Geology, geophysics. Rome, Carlo Colombo, (1956). 796 p.

080 Distillers Co. Ltd. The industrial activities of the Distillers Company Limited. Edinburgh, Distillers Co., 1957. 56 p.

080 Gas Times. Who's who in the gas industry 1957. London, Arrow Press, 1957. 226 p.

090 British Standards Institution. British standard method for the determination of acid and base numbers (neutralization value) of petroleum products by colour indicator titration. London, BSI, 1957. 11 p. (BS 2834 : 1957.)

090 British Standards Institution. Fastening threads of BSP sizes (formerly in BS 84 : 1940). London, BSI, 1956. (BS 2779 : 1956.)

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090 British Standards Institution. Machine screw nuts pressed type : B.A. and Whitworth form threads. London, BSI, 1957. 8 p. (BS 2827 : 1957.)

090 British Standards Institution. Methods of test for air filters used in air-conditioning and general ventilation. London, BSI, 1957. 41 p. (BS 2831 : 1957.)

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090 British Standards Institution. Yearbook 1957. London, BSI, 1957. 484 p.

090 Chase Manhattan Bank. Moving ahead with the atom, by P. F. Genachte. New York, Chase Manhattan Bank, 1957. 23 p.

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111 United States Geological Survey. Core tests and test wells, Oumalik area, Alaska, by F. M. Robinson ; with, Paleontology of test wells and core tests in the Oumalik area, Alaska, by H. R. Bergquist. Washington, D.C., U.S. Govt. Printing Office, 1956. 74 p. (Professional paper 305-A.) Exploration of Naval Petroleum Reserve no. 4 and adjacent areas, Northern Alaska, 1944–53. Part 5, sub-surface geology and engineering data.

205 United States Bureau of Mines. Characteristics and analyses on ninety-two Colorado crude oils, by W. J. Wenger, M. L. Whisman, W. J. Lanum, and J. S. Ball. Washington, D.C., U.S. Dept. Interior, 1957. 60 p. (Report of investigations 5309.)

250 American Society for Testing Materials. ASTM manual for rating motor fuels by motor and research methods : apparatus, maintenance, reference materials, service requirements, operation, installation. Philadelphia, Pa., ASTM, 1956. 173 p.

260 United States. Federal Supply Service. Federal test method standard : lubricants, liquid fuels, and related products ; methods of testing. Washington, D.C., General Services Administration, 1955. *In progress.* (Fed. test method std. no. 791.) Supersedes Fed. Spec. VV-L-791e.

270 American Society for Testing Materials. 1956 supplement to book of ASTM standards including tentatives. Part 1. Ferrous metals. Philadelphia, Pa., ASTM, 1956. 459 p.

270 Syndicat Général des Industries des Goudrons et Benzols. Spécifications et methodes d'analyse des produits benzéniques. Paris, SGIGB, (1956). *In progress.*

540 Mobil Oil Co. Ltd. Water removal from barrels of oil. London, Mobil, 1956. 4 p. (Industrial technical bulletin no. 21.)

640 Fire Protection Association. Buildings for the storage of flammable liquids. London, FPA, 1957? 2 p. (TIS 3002.)

720 Kellogg Co., The M. W. Iso-kel : a new isomerization process. New York, Kellogg, 1957? 6 p.

800 United States. Bureau of Mines. National motor gasoline survey Summer 1956, by O. C. Blade. Washington, D.C., U.S. Dept. Interior, 1957. 28 p. (Information circular 7779.)

810 Fire Protection Association. Oil-fired domestic boilers and air heaters for hot water supply and space heating : safety recommendations. London, FPA, 1957. 8 p.

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920 Chase Manhattan Bank. Investment patterns in the world petroleum industry, by F. G. Coqueron and J. E. Pogue. New York, Chase Manhattan Bank, 1956. 55 p.

920 Pogue, J. E., Hill, K. E., *and others.* Future growth and financial requirements of the world petroleum industry. New York, Manhattan Bank, 1956. 39 p. Paper for presentation at the annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, Petroleum Branch, Feb. 21, 1956. Joint authors are F. G. Coqueron J. G. Winger, J. R. Aaker, and J. P. Garten.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1014. Here's a new way to evaluate drillable prospects. D. A. Mabra. *Oil Gas J.*, 4.2.57, **55** (5), 186.—A method of evaluating drilling prospects is described in which a given test is analysed in 3 categories: structure, stratigraphy, and proximity to production. Points are given in each category according to a schedule. Structure is classified into max, excellent, good, and fair; stratigraphy into number of possible pay zones; and proximity into max, direct offset, oil or gas show (within approx 1000 ft), and 3 distance ranges. Points are totalled to complete the evaluation.

Examples of the method are given with diagrams for 3 Texas fields. C. A. F.

N

1015. Turbidity current and its importance in erosion and deposition of sediments. V. G. Gabriel. *World Oil*, 1957, **144** (2), 81.—The history of the turbidity current hypothesis is briefly reviewed. 4 refs. C. A. F.

1016. Recent trends in oil geology. 6. Improved logging methods. J. C. M. Taylor. *Petroleum, Lond.*, 1956, **19** (12), 431–4, 448.—This technological development is exemplified by advances in the methods available for obtaining sub-surface data from boreholes. The way in which these methods have kept pace with changes in drilling technique and increasing exploitation of limestone reservoirs is discussed. Electrical methods such as micrologging devices, focusing electrode systems, induction logging, and continuous velocity logging are mentioned, whilst unique ways that can be applied to penetrating thick limestone formation are also described. In concluding, the author relates some salient advantages of the new turbo-drill. E. A. G. H.

1017. South Central Texas' faults and folds. P. Fowler. *Oil Gas J.*, 14.1.57, **55** (2), 162.—The regional structural geology of S. Central Texas, comprising a 100-mile wide arcuate belt from the Rio Grande NE. to Brazos River, is described. It includes the Rio Grande embayment, the greater San Marcos arch, and the W. part of the E. Texas embayment. The ages of the movements are discussed, together with the phases of igneous and metamorphic activity in the area.

A map shows the main structural features of S. Central Texas, and a stratigraphic table showing periods of deformation and metamorphic activity is included. C. A. F.

1018. Texas Panhandle palæogeology. Pt 1. R. Roth. *World Oil*, 1957, **144** (2), 82.—The palæogeology of the Texas Panhandle is described with the aid of diagrams illustrating the stratigraphy, structure, and thickness variations of the formations from Cambrian to Mississippian. C. A. F.

1019. Abilene anticline indicates exploration potential. C. W. Shenkel. *World Oil*, 1957, **144** (2), 77.—The Abilene anticline is a well-defined structure extending for some 75 miles across N. Kansas within the Salina basin and is sub-parallel to the Nemaha ridge. Although oil has not yet been found in commercial quantities along the anticline, exploratory drilling has indicated that geological conditions offer good prospects.

The fold is shown at surface by the Wolfcamp, which dips gently W. and more steeply to the ESE. The sedimentary section above the pre-Cambrian core of the structure thickens southwards, and there are many formations present which are productive elsewhere in the basin or on the Central Kansas uplift.

Structure maps and a stratigraphic section of the area are included. C. A. F.

1020. B.C. looks ahead. F. J. Gardner. *Oil Gas J.*, 14.1.57, **55** (2), 161.—2 oilfields are now producing in British Columbia; these are Boundary Lake and Fort St John, both close to the Alberta border in the NE. part of the state. Boundary Lake is producing *ca* 21,000 b.d. of 34° oil from approx 17 ft of Trias Schooler Creek sand at *ca* 4300 ft, and in the Fort St John field, which produces mainly gas, 4 oil wells have been completed. Oil and gas has been found in this field in 7 pays of Permo-Pennsylvanian, Trias, and Lower Cretaceous age. C. A. F.

1021. The search for oil in Australia—a review of the work in progress. Anon. *Petroleum, Lond.*, 1957, **20** (2), 59–60.—Intensive search for oil throughout Australia and Papua continues. This paper summarizes latest developments. E. A. G. H.

1022. The oil geology of Europe. J. C. M. Taylor. *Petroleum, Lond.*, 1957, **20** (2), 49–55.—In essence this article attempts to relate the main existing oilfields, and other regions which are suspected to have oil possibilities, to the geological history of the area. Initially, fundamental conditions for the accumulation of commercial quantities of oil or gas in the earth's crust are detailed, and then applied to the geological structure of Europe. A valuable geological history of Europe is recounted, from the Lower Palæozoic era up to the Tertiary era. Various major oil-bearing zones are then discussed in relation to these historical periods, and finally various reasons for the concentration of hydrocarbons in individual fields are deduced. E. A. G. H.

1023. Tectonics of the region between Bremen and Cuxhaven. (In German.) W. Janowsky. *Erdöl u. Kohle*, 1956, **9**, 283–9.—Almost exclusively seismic reflection data and results of deep drilling are used in this article, profusely illustrated with profiles and isobath maps. Deposition of the mother salt bed—origin of the salt plugs—is discussed. Formation of salt plugs proceeds conformably with formation of basins and fault blocks. Many might be deposited already as "salt cushions" in the Triassic. The elongated salt structures have been extruded in the disturbance zone, firstly passive with the tectonic movements, in a later phase effecting an active anticlinal bulging of the Tertiary and Cretaceous overlying strata, combined with extending crest fractures. The round salt plugs seem only to be pressed upon by the load pressure of the Mesozoic strata in the synclinal regions. A relation certainly exists between ht of salt rise and depth of adjacent Tertiary–Cretaceous syncline. Also, within the Mesozoic a mass compensation between Tertiary and Cretaceous on the one hand and Jurassic and Triassic on the other is evident. 13 refs. R. T.

1024. Reds plan deep test. Anon. *Oil Gas J.*, 4.2.57, **55** (5), 97.—A well is to be drilled to *ca* 17,060 ft at Zyr, nr Baku on the Apsheron Peninsula, where the deepest producing well in Europe was drilled to 15,787 ft in 1955.

Turbo-drills are being used in several deep wells in the area; one has reached over 14,000 ft. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1025. The role of micro-indications of oil bearing in complex geochemical surveys. J. Glogoczowski. *Nafta* (*Krakow*), 1956, **12**, 4–8.—Micro-indications of oil deposits are due to diffusion and effusion. Gas which passes through various rock formations undergoes changes due to the physico- and biochemical nature of the rock and the rock in turn undergoes various changes due to the gas. On the surface there are changes in the soil and subsoil. The various strata form a chromatographic column from which hydrocarbons may in certain circumstances expel He. On the other hand, hydrocarbons found in the soil may be of origin other than oil deposits. There is little doubt when higher hydrocarbons are considered but methane can be produced by local vegetable decomposition. In places where the hydrocarbons are "micro-exhaled" the Polish IP workers found micro-organisms which live on them, leaving in the soil condensed and polymerized carbonaceous cpds which can be discovered by the use of bitumen index. However, other agents can cause similar polymerization, *e.g.* Fe_2O_3 and alpha radiation. This "bitumen index" and gamma radiation are other micro-indications, the latter coming from radon and helium. Other indications are the change in red-ox potential of the soil due to presence of hydrocarbons and to the presence of the products of their metabolism. Another micro-indication is the variation in the ratio of S to $SO_4^{=}$ ion. In areas overlying oil sands the proportion of halides in the soil is higher and there is a rise in SiO_2 and Al_2O_3. All these and other methods lead to a positive localization of oil-bearing sands. They should be used to supplement geological methods. M. S.

1026. Geophysics and petroleum dioclosure in Germany. (In German.) A. Bentz. *Erdöl u. Kohle*, 1956, **9**, 278–80.—Geology and stratigraphy of NW. Germany are described. Resulting from low-level prospecting—*ca* 200 salt plugs discovered—magnetic, gravimetric, and seismic refraction maps of all N. Germany are available. Up to 1939 many oilfields—mostly connected with salt plugs—were discovered. In Emsland, during world war II, anticlines were detected by seismic refraction and reflection methods, disclosing large oil accumulations. Under marine transgressions below 1200–2000 m old deposited structures are present frequently, exhibiting dome-like undulations, generally complicated by faulting. Between Weser and Ems, in spite of unfavourable tectonic conditions—folding, overthrusts, and faulting—seismic measurements have disclosed a series of important oilfields. All oilfields in NW. Germany produce currently from Jurassic or Cretaceous, oil having originated probably in deep sedimentation synclines. R. T.

1027. Speed problem in Swabish Foreland Molasse region. (In German.) H. John. *Erdöl u. Kohle*, 1956, **9**, 290–9.—The Molasse of the space analysed is divided geologically into Upper Sweetwater (OSM), Upper Sea (OMM), and Lower Sweetwater Molasse (USM). It exhibits—extending E.–W.—a strong asymmetrical syncline, filled up through 4 flows of different intensity and direction, with differing " sound-hard " sediments. The resulting velocity field contains—in a complex form—the influence of the hanging pressure, increasing from N. to S., otherwise the superimposed lithological field intensified from E. to W. Illustration 3 shows this clearly with isolines of total velocity gradients. Max of horizontal gradients and of velocity lie in SW. In this direction also occurs increase of velocity and of velocity gradients. Considering sound hardness in the E-space of the Molasse, it can be considered homogeneous. Functions derived therefrom—illustration 20—give logarithmic relationship between velocity and depth, and hyperbolic between vertical velocity gradients and depth. Graphic subtraction permits separation of hanging from lithological pressure in the total field, based on a normal field. The lithological velocity field is discussed in connexion with the decisive flows for the individual Molasse strata. A relative sound hardness scale is developed for these flows. Lithological velocity val as " reduced " velocities are produced for individual drill hole measurements. 2 presentations of these val in sectional drawings from the Molasse permit additional assertion for the geology with the help of correlated velocity intervals. R. T.

DRILLING

1028. Review of air and gas drilling. G. E. Cannon and R. A. Watson. *J. Petrol. Tech.*, 1956, **8** (10), 15–19.—In various parts of Texas and in New Mexico Humble has used air and gas drilling, usually with advantages. In one well 603 ft was drilled with gas at 69·3 ft/hr, compared with 4·3 ft/hr using mud for the equivalent interval. There was a 68-day saving in drilling a well by gas in another area. Drilling dry led to deviation troubles, and there appeared to be severe vibration of the bottom assembly. Annular velocities of *ca* 3000 ft/min were needed to clean out cuttings. Sometimes the air was supplemented with water to reduce caking problems.

Slim-hole drilling may reduce air requirements. Pressures of 125 p.s.i. are often adequate, but to start off air or gas drilling higher pressures may be needed to unload water from the hole, and higher pressures may be needed when penetration is rapid. Aerated mud has also been used. Air and gas drilling has been employed to get through lost-returns sections. It is preferable for success that there should be limited formation water, non-sloughing beds, and low pressures.

Precautions need to be taken against fire and explosion. Suitable equipment should preclude leakage to the derrick, and fans should clear gas from below the derrick floor. The matter of explosions has been studied, and it seems that there is little risk to personnel if they are kept clear of the stream of hot gases which would result from an explosion. G. D. H.

1029. Oils for cutting operations. A. E. Lawson and E. G. Ellis. *Petroleum, Lond.*, 1957, **20** (3), 99–102.—Investigation of new cutting techniques and the advent of automation are never divorced from association with cutting fluids, broadly classified into " soluble " (emulsifiable), " straight," or " oilless " (for grinding operations) types. The mechanism of lubrication is considered rather than cooling effects, which in any case are small in the case of gases and vapours. Finally, the constitutions of soluble and straight oils are outlined. E. A. G. H.

1030. Results of experiments on nozzle bits. L. Szostak. *Nafta (Krakow)*, 1956, **12**, 34–6.—In spite of the custom of using fishtail bits in soft shale formations, they are far from best, due to the fact that at greater speeds of drilling it is impossible to remove crumbled rock sufficiently fast. Several experiments were carried out by the Central Executive of Petroleum Industry, and their results are published. Bits were produced by the Drilling Equipment Factory, and the estimation of effectiveness was done in conjunction with the (Polish) IP. M. S.

1031. Fatigue strength of drill pipes. S. Karlic. *Nafta (Krakow)*, 1956, **12**, 9–12.—Mathematical analysis of forces acting on drill pipes in motion and suggestions for testing them to their fatigue limits. M. S.

PRODUCTION

1032. Impact of research on oil recovery. J. E. Sherborne and C. R. McOwen. *J. Petrol. Tech.*, 1957, **9** (2), 11–15.—Production research is largely a product of the last 25 years. At the beginning of that period most fields were largely operated under solution-gas drive, and reserve estimates were based on production decline curves. The volumetric approach was virtually unknown. Gradually knowledge was acquired of interstitial water and of the effects of dissolved gas. Information on fingering and coning had been obtained, while the important concept of retrograde condensation emerged. Permeability and relative permeability began to be measured, and the effect of gas saturation on water-flooding was studied.

Lab measurements of permeability did not necessarily agree with field deductions, and the effects of using air and waters of different salinities were examined. Statistical studies have suggested that the less time spent with drilling fluid opposite the producing formation, the higher a well's potential. Deposits in perforations and elsewhere reduce output. Reservoir performance is now far better understood, and improved methods have appeared for calculating the effect of energy available from gas cap expansion and influx of water, and the role of gravity drainage. The availability of high-speed digital computers is making it possible to use more exact equations with fewer simplifying assumptions in calculating field performance. G. D. H.

1033. Field test of the gas-driven liquid propane method of oil recovery. C. H. Jenks, J. B. Campbell, and G. G. Binder. *J. Petrol. Tech.*, 1957, **9** (2), AIMME Tech. Paper. No. 4457 34–9.—Conventional oil production methods generally leave 25–75% of the original oil underground. Lab tests using linear flow through permeable columns suggested that liq

propane injected into a depleted reservoir, followed by gas to displace the propane, caused the moving propane to drive oil ahead of itself. The field test used the Booch sandstone, 3500 ft deep, in the C-2 Block leases, Seminole County, Oklahoma. This had 5 producers and 3 dry holes. The porosity was 18% and permeability averaged 30 mD. The sand was 12–32 ft thick. The natural flow mechanism may have been solution gas drive. Water saturation was indicated to be 35%. The 38° API oil had a visc of 3 cP at 120° F. Wells were drilled for gas and propane injection on the E. and S., and 2 water injection wells in the N. to give a barrier in that direction. First 54 M.M.c.f. of gas was injected to build up the reservoir pressure above the vapour pressure of propane. 143,000 brl of propane were injected by 30 Oct 1953. Dry gas injection began in March 1954, and has continued with only minor breaks, giving a total of 325 M.M.c.f. Final primary oil production was 15 b.d. Early response to the injection gave 200 b.d., and the average rate since the start of the gas drive has been 130 b.d., the output since Aug 1953 being 112,000 brl of oil. Breakthrough of injected propane in all 5 producing wells occurred soon after starting gas drive. *Ca* 48,000 brl of propane has been produced. Some 280,000 brl of water was injected as a barrier, but most of this was expected to have gone N. The results of the field experiment are considered to be encouraging. G. D. H.

1034. Miscible slug process. A. A. Koch and R. L. Slobod. *J. Petrol. Tech.*, 1957, **9** (2), AIMME Tech. Paper No. 4458, 40–7.—The miscible slug process requires the injection of propane or LPG into the reservoir prior to gas injection. The conditions are maintained so that the slug is miscible with both the oil and the gas. This gives high recoveries from the zone of the reservoir swept. Experiments with long artificial cores, up to 123 ft long, show that $X = 31{\cdot}2\ L^{-\frac{1}{2}}y$ for unconsolidated sand and $X = 50{\cdot}6\ L^{-\frac{1}{2}}y$ for Torpedo sandstone. L is the reservoir path length in ft, y is the fractional concn of slug liq in the slug at the end of the path, and X is the slug size, expressed as a percentage of pore vol, needed to give a max slug concn at the end of the path. It appears that for radial systems the slug sizes may be comparable when the well-to-well distance is similar to the core length.

Increasing the reservoir pressure for a given system reduces the slug requirements. The higher pressure improves the phase relations. The higher the LPG–natural gasoline content of the reservoir fluid, the smaller the slug needed.

For homogeneous rocks slug requirements may vary little, but heterogeneous types, with vugs and fractures, may need larger slugs. At a mobility ratio of unity the rate of displacement seems to have little effect. The process may be of reduced attractiveness in watered-out reservoirs, because there is less oil, large vol of water will have to be handled, and the water may prevent the plug making contact with some oil.

Plugs of 2–3% may give very high oil recoveries.

G. D. H.

1035. Application of heat for recovery of oil : field test results and possibility of profitable operation. H. Walter. *J. Petrol. Tech.*, 1957, **9** (2), 16–22.—The Parker pool, nr Casey, Illinois, had poor primary recovery, and a water drive test over 17·5 acres gave only 23,000 brl in 5 years and was considered unsuccessful. The Pennsylvanian sand was 275 ft deep and 35 ft thick. The average porosity and permeability were, respectively, 20·8% and 175 mD, the average saturation with 26·3° API oil being 42%. The oil had a visc of 50 cP at 60° F. Tests began on 1 Sept 1953. The equipment produced a combustion gas–air–steam mixture at 500 p.s.i. and a max temp of 1000° F, at the rate of 25 tons/day. The composition of the mixture could be varied from 100% air to 53·34% steam. Tests started with 2 wells 30 ft apart. The intake well took 3 tons/day at first, rising to 14 tons/day after 100 days. 360 tons of gas–steam were injected in 60 days, giving a 20° F rise in temp at the bottom of the production well 30 ft away. At the end of 180 days the latter had given 500 brl oil and 1300 brl water, the surface temp being 225° F. There was evidence of subsurface oil combustion.

4 wells were drilled on a 110-ft square, 78 ft from the injection well. These produced as soon as they were opened. After a gradual increase to 90° F the temp rose rapidly to 225° F, and the oil production attained a peak at which it stayed for 20–40 days. Then gas production rose. The peaks for 3 of the wells were reached after 350, 420, and 500 days.

It is desirable to burn all the injected oxygen and to have steam as a heat conveyor, for it is better than nitrogen. No difficulty was experienced with underground ignition, which started spontaneously on attaining the right temp. Light oil was vaporized in the flowing gas, and it is likely that burning of the heavy residue followed. 37·6% of the heat was developed *in situ*. 80% of the oil in place was recovered. Based on the test results, it is estimated that over 121 acres requiring 100 injection wells and 165 production wells for 3 years recovery time, the cost would be $1,407,000 and for 5 years $1,737,000, while the respective profits, before taxes but after royalties, would be $2,813,000 and $2,483,000.

G. D. H.

1036. Selective plugging of injection wells by *in situ* reactions. W. F. Hower and J. Ramos. *J. Petrol. Tech.*, 1957, **9** (1), 17–20.—The use of short-half-life radioactive isotopes has allowed the measurement of the distribution of injection water. It has shown considerable irregularities and the need for remedial action. Partial plugging of the offending formations can be obtained by injecting a soln capable of being strongly adsorbed on the rock surfaces; injecting a small water spacer; and finally injecting a soln which reacts with the first soln to give a water-insoluble gelatinous precipitate. Normal well fluids do not dissolve the precipitate, but it can easily be removed by HCl. In one method of emplacement, water is pumped down the annulus and soln made radioactive down the tubing, the rates being adjusted so that the soln enters the rock at known points.

Several examples of the use of this treatment are described, with test data before and after the plugging.

Where complete plugging is needed or where acid may have to be used to improve the permeability of other zones, a thin liq is injected, and this sets to a very stiff gel in 4–6 hr.

G. D. H.

1037. Hydraulic fracturing in the Caddo-Pine Island field. B. F. Patterson. *J. Petrol. Tech.*, 1957, **9** (1), 11–16.—Caddo-Pine Island is a faulted dome with a major oil accumulation in the Annona Chalk on the downthrown S. side of the Oil City fault. Production from this horizon is 1300–1470 ft subsea. The Chalk porosity is 25–28%, permeability up to 1·5 mD, water saturation 30–60% (even 75% but still productive of oil), producing thickness 140–160 ft. The drive is gravity drainage. The original pressure may have been 750 p.s.i.g.; in 1955 some wells prior to fracturing had pressures of 100–200 p.s.i.g., and 300–400 p.s.i.g. after fracturing. Chalk wells are now completed in 3–5 days. Costs are $2400–3500, but drainholes, which have been used in 30–40 wells, double the cost. Acid treatment was used in Chalk wells from 1936, and the first fracture treatment was in 1953. The average cost of fracturing is $2500–3500. The largest treatment used 250,000 lb sand and 2500 brl of heavy oil, requiring 8 hr pumping. If there is no breakdown with oil, 500 gal of 15% HCl is used ahead of the sand. In selectively treating old wells temporary plugs are used to seal off low-pressure thief zones.

Power costs for pumping are $5–10/month/well. Just before the use of fracturing the average rate/well in the Chalk area was 3–5 b.d.; 30 months later the average was 4·8 brl.

Some comparisons are made between acidized wells and fractured wells.

The oil recovery is thought to be only 10–20% and so the reservoir may be good for testing new methods. G. D. H.

1038. Performance of a solution gas drive reservoir, Rosenwald pool, Oklahoma. M. R. Smith and J. H. Henderson. *J. Petrol. Tech.*, 1957, **9** (1), 25–9.—The Rosenwald pool, discovered in June 1949, produces from the Union Valley limestone and Cromwell sand at depths of *ca* 3450 ft. The 2 horizons form a common reservoir limited by pinch-out of the sand in all directions and loss of permeability in the limestone. 31 wells were drilled on 10-acre spacing. Sand porosity is 12% and permeability 100–2000 mD, except on the edges; bedding planes seem not to affect the properties. The limestone has a porosity of 5·4% and permeability less than 5 mD. The crude oil appears to have been gas-saturated initially, with no gas cap. The wells flowed until Feb 1951, the output having fallen from 1500 b.d. in Dec 1950 to 350 b.d. Then pumps were installed, the output falling to 47 b.d. from 18 wells in Dec 1953. Water-flood operations began in 1954, the primary recovery having been 536,640 brl. There was no evidence of gas cap or water drive.

Material balance indicated $2{\cdot}66 \times 10^6$ brl of oil in place, and volumetric calculations $2{\cdot}3 \times 10^6$ brl.

When *ca* 6% of the oil in place had been recovered, future performance was calculated via a k_g/k_o curve constructed from data for other Cromwell pools, assuming 5% equilibrium gas saturation. An ultimate recovery factor of 26·5% to 50 p.s.i. abandonment was calculated. Actual recovery was 20%. The gas–oil ratios rose more rapidly than was predicted. A k_g/k_o curve was constructed from field performance. Lab measurements on cores by the transient flow technique were closer to this than was the assumed curve. G. D. H.

1039. A theory for the effect of heating oil producing wells. A. Schild. *J. Petrol. Tech.*, 1957, **9** (1), AIMME Tech. Paper No. 4447, 1–10.—Heating a well opposite the producing sand can be beneficial, especially with heavy oils. Assuming radial flow, in general a somewhat simplified visc–temp relationship, and other factors, the principal deductions relate to steady-state conditions, where the transfer of heat away from the well at all points is balanced by the carriage of heat towards the well by the oil. Most of the results are presented in dimensionless form. The permeability and pressure drop do not appear in the final results. At high production rates the temp drops rapidly with distance from the well. For sufficiently high original producing rates, the production increase due to heating is substantially independent of the original rate.

Checks show that the approximation made with respect to visc relationships does not give a large error (5–15%). A simplified analysis of the steady-state heat requirements suggests that there may be an upper original producing rate beyond which heating is unprofitable. This figure may have to be reduced when other factors are considered, but by delaying the abandonment date by boosting the rate higher ultimate recoveries may be obtained.

Study of the transient phase suggests that production ratios of more than 2·5 cannot be obtained in heating times which are sufficiently short to be of practical interest, *i.e.* a few months to one or 2 years. Some benefits may accrue from the reduction of emulsion formation near the borehole.

G. D. H.

1040. Development of shaped charges for oil well completion. T. C. Poulter and B. M. Caldwell. *J. Petrol. Tech.*, 1957, **9** (1), AIMME Tech. Paper No. 4448, 11–18.—A theoretical study of the principles involved in jet formation by a shaped charge and the mechanism of penetration of the target by the jet showed that 10 and perhaps as many as 15 variables affected the performance of a shaped charge. Experimental investigation of all the different combinations of these variables was therefore impracticable. The more important features to be considered are: (1) design of the charge; (2) shaping of the detonation front; (3) transition of the metal liner into a jet; (4) characteristics developed in the jet; (5) penetration of jet into target; (6) characteristics required of hole in target. A case history is discussed in the light of these features, with special reference to the various possible mechanisms involved in the transition from cone to jet. The detonation front was shaped by superimposing a high-order detonation on a zone already undergoing low-order detonation.

The charge developed met the initial specifications: the entrance hole was increased fourfold; a slight increase in penetration was achieved; the hole vol was increased *ca* threefold without increasing the amount of explosive; slug was virtually eliminated. G. D. H.

1041. Compositional material balance method for prediction of recovery from volatile oil depletion drive reservoirs. F. O. Reudelhuber and R. F. Hinds. *J. Petrol. Tech.*, 1957, **9** (1), AIMME Tech. Paper No. 449, 19–26.—Conventional depletion-drive calculation methods lead to incorrect estimates of ultimate recovery when applied to volatile oil reservoirs. The differential procedure and the combination differential-flash procedure have therefore been replaced by the constant-vol depletion procedure. For this the lab data must be obtained in an appropriate manner. A known vol of reservoir fluid is placed in a windowed phase cell at reservoir temp and its vol is accurately measured at the saturation pressure. The pressure is dropped to the first level, and the system allowed to reach equilibrium. Gas phase is removed to leave the system at the original measured vol. The material removed is analysed, and the remaining gas and liq vol are measured. This is repeated at lower pressures and at the end the remaining liq is analysed. Compositional material balance is possible via these data.

With the vol and composition of the well stream known, the final step is to perform the separator recovery calculations. Curves and tables provide the data of a specific example, and the step-by-step procedure is given as an appendix.

G. D. H.

1042. Method of predicting depletion performance of a reservoir producing volatile crude oil. R. A. Jacoby and V. J. Berry. *J. Petrol. Tech.*, 1957, **9** (1), AIMME Tech. Paper No. 4448, 27–33.—Conventional methods are unsatisfactory for predicting the performance and recovery of volatile oils, because lab differential vaporization procedures do not adequately represent the reservoir mechanism and surface separator facilities. The overall composition of the fluid entering the well and the separation conditions must be known at each stage of depletion.

The state and composition of the reservoir fluid is required at the initial pressure. There must be suitable sets of equilibrium vaporization ratios covering the range of reservoir conditions and the separator conditions. Some experimental liq phase densities at reservoir conditions are useful for purposes of checking, and experimental oil-phase visc data at reservoir temp are needed.

A stepwise method of calculation is used to make the predictions. In the example given the cumulative stock-tank oil recovery estimated is 2½ times that predicted by conventional methods; the oil reservoir vol factor was 4·7. The method gives composition data for all phases and streams, and the data are useful for separator, crude stabilization, and gasoline plant studies. G. D. H.

1043. Compressibility of natural gases. A. S. Trube. *J. Petrol. Tech.*, 1957, **9** (1), 69–71.—The isothermal expansion coeff for reservoir gases are usually quite variable, and often highly pressure sensitive; reservoir liq have coeff less pressure sensitive. The coeff of isothermal compressibility is $c = -\frac{V_1 - V_2}{V_1(p_2 - p_1)}$, where $V_1 > V_2$ and $p_2 > p_1$, and the relationship is satisfactory as an approximation when the pressure change is small. It is preferable to use $c = -\frac{\partial V}{V \partial p}$, giving the instantaneous coeff of compressibility. When c is constant, $c = \frac{\ln V_1 - \ln V_2}{p_2 - p_1}$, and the plot of logarithm of vol *v.* pressure will be linear. When c is variable this linear relationship will not hold. From $pV = zn\,RT$ it can be shown that the coeff of isothermal compressibility of gases is $c_g = \frac{1}{p} - \frac{\partial z}{z \partial p}$. At low pressure z decreases as p increases, and at high pressures z increases as p increases. Gas compressibilities can be obtained from PVT lab data on samples. In dimensionless form, since $p = p_c \cdot p_r$, the last relationship is $c_g \cdot p_c = \frac{1}{p_r} - \frac{\partial z}{z \partial p_r} = c_r$, the pseudo-reduced compressibility (p_r is pseudo-reduced pressure and p_c pseudo-critical pressure). On the basis of the last equation, published data have been plotted as pseudo-reduced compressibility against pseudo-reduced pressure for various pseudo-reduced temp. G. D. H.

1044. Centrifuge core cleaner. F. R. Conley and D. B. Burrows. *J. Petrol. Tech.*, 1956, **8** (10), 61–2.—The core basket of the centrifuge is made of mild cold-rolled steel, being 7½ inches dia and 1½ inches deep. It holds 18 1-inch samples and is attached to a cone fitted to the shaft of an electric motor. The core and outer rim have perforations for the passage of hot solvent, which is introduced through the hollow hub. A felt pad is placed inside the outer rim of the basket and the cores are symmetrically distributed. The operating speed is 550 rev/min. Hot solvent (usually chloroform) is fed from a still via a siphon to the hub; it strikes the inner faces of the cores and emerges with oil from the outer face, then, passing back to the still via an observation cell. Cores of varying porosities and permeabilities were cleaned in *ca* 20 minutes, whereas the same cores still had 17% of the oil after 41 hr in a Soxhlet extractor. With care soft cores can be extracted by centrifuging, but it may be necessary to use lower speeds. G. D. H.

1045. Application of the gelatin model for studying mobility ratio effects. M. B. Burton and P. B. Crawford. *J. Petrol. Tech.*, 1956, **8** (10), 63–7.—The model was on a plastic base with ½-inch plastic strips mounted to define the area studied, narrow apertures in the boundary representing wells. Behind each well was a rectangular area, also outlined by plastic strip. The electrodes were made from copper sheet, and were large, so that the potential drop behind the salt bridge (well) was small.

The coloured sweeping ion was $Cu(NH_3)_4^{++}$. The uncoloured swept ion was used to control the conductivity (or effective mobility) ratio. The chloride was used to give a common anion. At 0·2N concn Cd, Mn, K, and H gave relative to $Cu(NH_3)_4^{++}$ conductivity ratios of 0·5, 0·85, 1·2, and 3, respectively. 6% agar agar soln was prepared, and 0·04N soln of the colourless ions. For a given test equal vol of liquefied gelatin and the ion soln were mixed to give 0·2N soln, which were poured to set in the model (not in the space behind the well). The copper soln was placed in the anode area and 0·4N HCl in the cathode area. 60 milliamp was suitable for spacings of 4–6 cm between salt bridges. A run needed *ca* 15 minutes. Both anode and cathode liq have to be renewed. Sweep progress was drawn on thin plastic sheets.

Vertical and horizontal fractures could be simulated by copper strip. Some experiments were designed to represent an area of *in situ* combustion. Reproducibility was 3–5%. G. D. H.

1046. Evaluation of a gas drive method for determining relative permeability relationships. W. W. Owens, D. R. Parrish, and W. E. Lamoreaux. *J. Petrol. Tech.*, 1956, **8** (12), AIMME Tech. Paper No. 4417, 275–80.—Lab tests to get the gas–oil flow characteristics of reservoir rock samples employ steady-state, unsteady-state, or the stationary liq technique. A simplified unsteady-state (gas-drive) technique has been studied in order to get k_g/k_o data on small core samples. It was found that the test specimens must be very carefully selected so as to ensure uniform permeability and porosity. This involved visual inspection, X-ray examination, and some flow tests.

The apparatus used a separator consisting of a semi-permeable, closely-woven cloth barrier near the exit end of the specimen. The effects of oil visc, gas expansion, and pressure differential were studied. Experience suggested that an oil of 25 cP was most suitable, and that the pressure differential should be such as to give a downstream gas output of ½ the pore vol of the specimen in 1 minute or less. The latter minimized the "end effect" and ensured that the passage of the "stabilized zone" had a negligible influence on the results. Tests show that the calculation of k_g/k_o relationships by Welge's method gives results which are not influenced by gas expansion.

The gas-drive technique has given results compatible with the steady-state method. It is more rapid and less complicated than other methods. Semi-routine tests should be possible by the gas-drive technique. G. D. H.

1047. Gas slippage and relative permeability measurements. R. K. Estes and P. F. Fulton. *J. Petrol. Tech.*, 1956, **8** (10), 69–7.—2 synthetic Alundum cores, 2 sandstones, and one limestone were used in the studies. Their permeabilities ranged 32–663 mD. Soltrol, a low-vapour-pressure oil, was used. Flow rates were measured by soap films. Measurements gave a family of Klinkenberg plots for each sample, the slopes decreasing with increased liq saturation, and reversed slopes were found at high liq saturations, possibly due to experimental difficulties. It was concluded in the relationship $K_g = K_l\left(1 + \frac{b}{p_m}\right)$, b varies inversely as r (pore radius), because bK_l is primarily influenced by changes in K_l with increase in liq saturation.

It appears that for porous media having a considerable range of permeability, pore size, and pore-size distribution, the slip correction is roughly constant at all liq saturations for steady-state gas flow. Provided the effective and specific permeabilities are determined at the same mean pressure, the gas relative permeability function is independent of the mean pressure. G. D. H.

1048. Petrophysical analysis of some Wilcox wells. S. M. Paine. *J. Petrol. Tech.*, 1956, **8** (10), 25–31.—The Wilcox of the central and E. part of the Texas Gulf Coast trend is heterogeneous. There are relationships between some of the fundamental rock properties, but quantitative evaluation, using electric logs and established correlations, is often difficult because of variations in shale content and cement, in water salinities, thin bed and invasion effects. Electric logs may nevertheless be used, provided that due care is taken in their interpretation. Gas and oil have been produced without salt water from sectors for which the interstitial water was calculated as 30–50%; only water was obtained where the water content was calculated to be 60%.

To illustrate the characteristics of the formation and the utility of the various logging devices, representative wells are discussed in some detail. Drill cuttings and sidewall cores can be most helpful, and from them capillary pressure curves can be obtained. Porosities and permeabilities can be deduced. Conventional cores are thought not to be essential in exploring this trend of the Wilcox.

A programme is suggested for evaluation of the Wilcox in exploratory wells. This is a general programme to be used flexibly. Muds should have low water-loss, and should have properties compatible with the logging programme. Cuttings and sidewall cores should be analysed; 24-ft lateral and 24-ft inverted lateral are needed in logging, and 40-ft lateral if the porosity is less than *ca* 15%. Electric log surveys should be run every 2 weeks. Guard laterolog or focused 40-inch induction logs may help. Drillstem tests are needed in questionable sectors, and conventional cores of commercial zones in the well following a discovery.

G. D. H.

1049. Practical solution of gas-flow equations for wells and pipelines with large temperature gradients. M. H. Cullender and R. V. Smith. *J. Petrol. Tech.*, 1956, **8** (12), 281–7.—Rigorous equations are derived for calculating subsurface pressures in flowing and static gas wells, and pressures in horizontal pipelines. They are based on energy balance, assuming the change in kinetic energy of the gas flow to be negligible, and can be used with straight-line or curved temp gradients. Turbulent flow is assumed, and friction factors are based on an absolute roughness of 0·0006 inch.

The general equations are solved numerically and are easily adapted to automatic computers. Examples are given for flowing and static gas columns in wells and for pipeline flow. Trapezoidal and Simpson's rules can be applied to the integration of the flow equations. Values of a factor dependent on friction are tabulated for various tubing and casing sizes. There is also an alternative factor for cases where the tubing is smoother than usual (absolute roughness = 0·0001 inch).

G. D. H.

1050. Gravity drainage performance of depletion-type reservoirs in the stripper stage. C. S. Matthews and H. C. Lefkovits. *J. Petrol. Tech.*, 1956, **8** (12), AIMME Tech. Paper No. 4418, 265–74.—In depletion-type reservoirs, when the pressure has fallen to a low value, gravity is the sole driving agent. Scaled-model experiments and theoretical studies of gravity drive have been made. The theory fits the model data well, and is also in agreement with some field data. In the model studies the effects of relative permeability were examined, and other factors investigated were the effects of changes in well radius, visc, absolute permeability, saturated sand thickness, and of not pumping the well bore dry. A pumped-off well produced its oil faster than incompletely pumped-off wells.

According to the theory, when the range of production rates to be considered is less than 25-fold, the production rate decline curve for a homogeneous reservoir with a free surface will be hyperbolic, with $n = 2$, and $q/q_i = (1 + \gamma t)^{-2}$, where q_i is the oil rate at time $t = 0$ ($t = 0$ may be arbitrary), and $\gamma = q_i/Q_u$, Q_u being the ultimate production to $t = \infty$.

G. D. H.

1051. Water coning before breakthrough—an electronic analogue treatment. W. J. Harplus. *J. Petrol. Tech.*, 1956, **8** (10), AIMME Tech. Paper No. 4351, 240–5.—When a well partially penetrates an oil zone over water, and there is production at a constant rate, the oil–water interface will assume a new shape which will become static after a transient phase. The mathematical formulation of the problem of finding this shape is given. The calculus of finite differences allows the basic equation to be converted to a series of algebraic equations suitable for computer solution.

By means of a finite difference expansion a fluid-flow field in cylindrical co-ordinates with axial symmetry can be represented by a network of electrical resistors, because of the essential similarity between the equations describing the voltage distribution in such a network and those derived by finite difference expansion of Laplace's equation. This electrical analogue is discussed, and it is noted that a series of d.c. analogue computing units connected to the network boundary corresponding to the free surface will effectively adjust the network parameters to satisfy simultaneously Laplace's equation and the boundary conditions. Operating procedure is described. Once the basic resistance network has been designed and constructed, the water-cone shape for any combination of flow rates, density contrasts, and mobility ratios can be obtained in a few seconds.

With minor modifications other problems can be studied: effects of sand anisotropy, symmetrical shale lenses, gas coning.

G. D. H.

1052. Results of (experiments on) water flooding (of oil deposits) in Poland. A. Mikucki. *Nafta (Krakow)*, 1956, **12**, 36–9.—Flooding of Polish wells started in 1949 in Gorlice Region (field "Lipa"), and results obtained led to alterations which were applied in the second experiment at Potok Region (field "Amelia"). Summary of results is given in tables. Further work is intended.

M. S.

1053. Olympic Pool water flood. W. E. Stiles. *J. Petrol. Tech.*, 1957, **9** (2), 29–35.—The Olympic field in Hughes and Okfuskee Counties, Oklahoma, produces from the Senora sand (Pennsylvanian) at depths of *ca* 1800 ft. 343 producers were drilled on 10-acre spacing. Average initial potentials were 400 b.d. Solution gas provided the principal drive, but there was a gas cap. Peak primary output was in 1937 (average 11,612 b.d.); at the end of 1948, 301 wells were giving 727 b.d., the aggregate being 13,884,700 brl. A gas injection test started in 1937 and, affecting 900 acres, had given 267,000 brl of this total. Experimental water injection began in Dec 1948, using water from the Calvin sand and a closed system. The first "kick" from this occurred after 9 months. Hitherto the wells in the test area were giving 4 b.d. each; after 23 months the average was 220 b.d. each, the water–oil ratio being about one.

Core analyses of input wells showed 19·2% porosity, 28 mD permeability, 39% interstitial water, and 28% oil. Except for the N. end of the field a 5-spot, 10-acre, water-flood pattern was used, and by May 1954 there were 219 input wells and 245 producing wells. Electric power was used for pumping. For a period Arbuckle water was used for injection by a closed system, but this proved highly corrosive, and a switch was made to water from river alluvium, with an improvement in injectivity. There was still some corrosion, apparently of bacterial origin, but this was controlled by chemicals. Cumulative water injection was 115×10^6 brl at the start of 1956; the daily rate was then 90,000 brl; nearly 15×10^6 brl of oil had been obtained by water flooding. The ultimate recovery due to water flooding is estimated as 25×10^6 brl, assuming that operation will be possible at 98% water cut.

G. D. H.

1054. Laboratory study of solvent flooding. H. N. Hall and T. M. Geffen. *J. Petrol. Tech.*, 1957, **9** (2), AIMME Tech. Paper, No. 4456, 48–57.—Even after thorough gas drive or water flooding most oil reservoirs retain $\frac{1}{3}$ to $\frac{1}{2}$ of their original oil. The displacement is by a fluid immiscible with the oil. A solvent miscible with the oil has advantages, and can be used in a relatively small amount if it is used as a buffer between the oil and injected gas. The arrangement between

an injection well and a producing well will then be: gas; gas and solvent; solvent; solvent and oil; oil. If the operating pressure is below the critical pressure of the natural gas–solvent system the displacement will be only partially miscible.

The experimental work employed long cores, and used not only miscible hydrocarbon systems, but also brine and brine–glycerine mixtures. The length of the mixing zone appeared to attain a max after an appreciable travel. The logarithm of the mixing zone length was found to be related to the logarithm of the visc difference–visc ratio. Over the range studied, the mixing zone length was independent of the displacement rate, but the latter may affect the development of the mixing zone.

Above the critical pressure of the natural gas–solvent system there is complete miscibility throughout the reservoir and only one phase present at any point. 2 mixing zones are separated by solvent. Dry gas is then able to replace oil with good recovery efficiency in the part of the reservoir contacted. Below the critical pressure there will be a 2-phase region, but it is suggested that with end-to-end displacement part of the flowing gas should be withdrawn from an intermediate well in the 2-phase zone, and after stripping, the solvent is put into the solvent bank ahead of the 2-phase zone. It is estimated that the total solvent needed is less than 10% of the hydrocarbon pore vol to be displaced. G. D. H.

1055. Darcy's law and the field equations of the flow of underground fluids. M. K. Hubbert. *J. Petrol. Tech.*, 1956, **8** (10), AIMME Tech. Paper No. 4352, 222–39.—Darcy's law was formulated in the appendix to a treatise published in 1856, and was based on experimental observations on flow through sand filters. The physical and mathematical implications of this law are examined, and a more general form obtained. Also the relationship is derived directly from the Navier–Stokes equation of motion of visc liq. This is shown to be applicable to liq generally, and to gases at pressures above *ca* 20 atm, *i.e.* under conditions common in many oilfields. The permeability constant is analysed and shown to comprise a shape factor and the square of a characteristic length of the pore structure. Poiseuille's law and flow between parallel plates are indicated to be special cases of Darcy's law, rather than the reverse. Some experiments seem to suggest that turbulence arises at flow velocities of the order of several hundred times that at which Darcy's law fails.

Parallels exist between fluid flow in porous media and the conduction of heat and electricity. However, the latter has no counterpart with the flow of immiscible fluids. It has commonly been assumed that the flow lines of the various components are parallel. For saturations greater than some critical minimum, the flow follows Darcy's law, taking note of the relative permeability value; for saturations less than this there will be a general drift of discontinuous fluid elements, as occurs in oil migration and accumulation. The segregated oil and water will be separated by an inclined plane when one or both are in motion. The horizontal component of the flow must be parallel to the direction of steepest slope of the interface when only one fluid is flowing. At the interface the equi-pressure surfaces in the 2 fluids must match, neglecting pressure differences due to capillarity.

Careful investigations show that the errors attributed at times to Darcy are incorrectly assigned. G. D. H.

1056. Some problems of fluid mechanics in natural gas reservoirs. W. Schiller. *Nafta (Krakow)*, 1956, **12**, 12–17.—Following the paper by W. Kulczycki in *Nafta (Krakow)*, 1955, **11**, the author develops the theory of fall in underground pressure, taking into consideration p_k, pressure at rad R_k, p_o, pressure at rad R_o, k, permeability, m, porosity, h, vacant vol in sand, Q, gas velocity in cu. m/sec at NTP. γ_{at}, gas density at p_{at}, g, gravity constant, μ, gas visc, arriving at

$$p_k^2 - p_o^2 = \frac{\mu p_{at} Q}{k\pi h} \ln \frac{R_k}{R_o} \cdot \frac{6 \times 10^{-5} p_{at} \gamma_{at}}{m\sqrt{kg}} \left(\frac{d}{\sqrt{k}}\right)^2 \frac{Q^2}{\pi^2 h^2} \left(\frac{1}{R_o} - \frac{1}{R_k}\right)$$

M. S.

1057. Relation between gamma radiation and permeability, Denver–Julesburg basin. C. L. Rabe. *J. Petrol. Tech.*, 1957, **9** (2), 65–7.—The Muddy and Dakota sands occur over a large area. The bonding material is for the most part clay, so there might be some relationship with permeability, and thence with gamma radiation. Corrected γ-ray deflections for 5 wells over an area 50 miles long and 8 miles wide showed some relationship with permeability. Because all logs are not recorded at the same sensitivity or in the same calibration units the deflection for the bentonite marker provided a max deflection point for converting logs to a common scale. Corrections were also made for thin-bed effects, the best results arising with a "drag" value of *ca* 1 ft. The γ-ray-permeability relationship does not apply to the calcareous and siliceous cemented specimens sometimes met with in the basin. G. D. H.

1058. Deepest well plugs back, but still champ. Anon. *Oil Gas J.*, 4.2.57, **55** (5), 82.—I.L.L. and E. Humble L State Lease 2414 in Plaquemines Parish, nr New Orleans, Louisiana, is the world's deepest producing well. It was originally completed at 21,443–21,465 ft, but because of sand trouble it has been recompleted at 20,741–20,745 ft with flowing production of 270 b.d. and G.O.R. 2100 cu. ft/brl. From test data b.h.p. is estimated at *ca* 17,500 p.s.i. An offset is being drilled. C. A. F.

1059. Laboratory tests of P.V.T. relations and viscosity of bottom-hole samples. D. Klanjscek. *Nafta (Yugoslavia)*, 1956, **7** (12), 363–7.—The lab equipment and test methods in use are described. Some results of first tests of Yugoslav oils are given by means of diagrams with a short discussion. (Author's abstract.)

1060. Fluid injection in petroleum reservoirs of the United States—history and results. H. Power. *Ingenieur, 's Grav.*, 7.12.56, **68** (49), M51–6.—Survey of the results of fluid injection projects in Pennsylvania (Bradford field), New York, Kansas, Illinois, Texas, Oklahoma, Virginia, California, Arkansas, Louisiana, and Wyoming. 1 fig, 27 refs. (Author's abstract.)

1061. Petroleum possibilities in Parana (Brazil) basin. (In German.) G. Mempel. *Erdöl u. Kohle*, 1956, **9**, 299–303.—Following a review on the stratigraphy and tectonics, petroleum possibilities of the basin are discussed. In the past 50 years *ca* 100 shallow drillings—up to 500 m depth for petroleum or coal have been made in the Parana basin. In many traces of oil were found. Prospects of discovering petroleum in industrial quantities in the known regions do not appear favourable. However, only part of this vast basin has been explored. Many years of geological, geophysical, and drilling work are required before conclusive judgment on petroleum possibilities of this basin can be passed. R. T.

1062. Russian work on strata fracturing. 1. Anon. *Petroleum, Lond.*, 1957, **20** (3), 106–7.—Fracturing work in the Russian oilfields of Tortar and Bashkir, where well pressures amount up to 300 atm, is reported. Fracture was indicated by a multiple increase in the reception or absorption coeff in the well, together with a substantial absorption of sand in the strata. Work to show the changes in the mean permeability of the seepage zones was performed and a new hydrodynamic formula for k_{mean} drawn up. E. A. G. H.

OILFIELD DEVELOPMENT

1063. Lousiana offshore. G. I. Atwater. *Oil Gas J.*, 11.2.57, **55** (6), 96.—The most important oil province of the continental shelf of the Gulf of Mexico lies offshore from S. Louisiana, where the beds of the coastal Miocene producing trend dip gently S. and thicken appreciably seawards. Predictions of discoveries and developments in the area are given based on analyses of the geographical distribution, geology, and reserves of adjacent onshore fields where geological conditions are similar. These forecasts are shown in a series of diagrams, and it is estimated that over 70 fields will be discovered in the area having a total reserve of 4·6 billion brl.
C. A. F.

1064. Athabasca heralds a new era. F. J. Gardner. *Oil Gas J.*, 4.2.57, **55** (5), 185.—Large-scale operations designed to exploit commercially the Athabasca tar sands of Alberta are to start early this year. Since 1897 numerous attempts to exploit the sands profitably have been unsuccessful, and in the new venture the process involves separating the oil and sand by centrifuging, followed by coking and desulphurization of the oil. $50 million is to be invested for an anticipated initial capacity of 20,000 b.d.

Total estimated reserves of the tar sands vary from 100 to 500 billion brl gross, but surface mining is applicable to only a minor part of the deposit. C. A. F.

1065. Israel steps up drilling and production operations. Anon. *World Oil*, 1957, **144** (2), 166.—Only one oilfield has been found in Israel, at Heletz *ca* 30 miles S. of Tel Aviv, where the discovery was completed in 1955. 8 producing wells have since been drilled, of which 6 are currently producing. 5 wells are being drilled in the field and tests are also being made at Brur, SW. of Heletz, and in the Dead Sea area near the site of Sodom.

Estimated reserves of the field are not expected to be less than 10 million brl, and may be as high as 50 million brl. Between 60 and 100 wells will be required for complete development of a productive area of *ca* 500 acres minimum, but limits have not yet been proved. Effective oil column is at least 260 ft, and pay is sand. C. A. F.

1066. India's oil projects. T. V. R'Chandran. *Petroleum, Lond.*, 1956, **19** (11), 397, 400.—A large area of territory in Upper Assam is to be explored for oil by the Assam Oil Co, the Indian Government controlling a ½ share. To deal with new crude supply a new refinery is envisaged in the Calcutta district necessitating the construction of a pipeline 850 miles long at a cost around £5¼ million. Further oil exploration is pending in W. Bengal in collaboration with the Standard Vacuum Oil Co. Russian, German, and Canadian assistance in other exploration programmes is also mentioned.
E. A. G. H.

1067. Oil production in Holland. Anon. *Petroleum, Lond.* 1957, **20** (2), 47–8, 55.—A concise survey of oil exploration in Holland is given back to the discovery of initial deposits in 1923. The formations which gave rise to petroleum in Holland are explained in terms of its unusual geological history. Exploration methods involved the use of gravimetric observations, seismograms, and other modern techniques. In conclusion, the present-day outputs of oil and natural gas are mentioned and development hopes for the future.
E. A. G. H.

1068. Germany looks up. Anon. *Oil Gas J.*, 25.2.57, **55** (8), 99.—W. German production in 1957 is expected to average 73,100 b.d., 7·5% higher than in 1956, and output should rise for at least another 4 years. Successful drilling in 1956 increased potential in Holstein–Hamburg, Weser–Ems, Bavaria, and Hanover. The future of Emsland and the Upper Rhine Valley is less hopeful.

Natural gas production in 1956 averaged 35,500 M.c.f./day, 53% higher than in 1955. Most of the production comes from the Rehden field near Diepholz, and Bentheim. Several fields are under restricted production. C. A. F.

1069. Realization of six-year plan completed, we are entering into five-year plan. S. Dutka and J. Wojnar. *Nafta (Krakow)*, 1956, **12**, 1–3.—Although overall increase in production was in accordance with the aims of the 6-year plan, there are individual branches of industry which failed to reach their planned objectives. In particular, the total production of crude during the 6 years reached only 70% of the figure aimed at. Gasoline production has reached a figure 7% in excess of plan. Geoseismic work had been neglected until mid-1955 due to lack of equipment and trained personnel. Exploratory drilling was only done to the extent of 50%, whilst overall completion of drilling reached 59%. Between 1950 and 1955 the proportion of rotary drilling rose from 30 to 80%. Secondary production methods yielded 40% more in 1955 than in 1950. 2 new factories produce drilling equipment. The 6-year plan in refining has been exceeded in tonnage by 15·9% and in the value of products by 20·2%. Refining capacity exceeded plan by 26%. The amount of crude refined rose by 275% since 1949, tower dist by 226%, and solvent refining by 300%. Consumption of petroleum products is now 60 kg/head of population, and in 1960 it is to be 120 kg. Plans for a new refinery have been considered. For the next 5 years it is planned to speed up drilling, especially of exploratory nature in the N. Lowlands. Turbo-drill will be used in up to ½ the work. M. S.

1070. Science and technique in Soviet Union—reserves of future development of petroleum industry in USSR. J. Czaplicka. *Nafta (Krakow)*, 1956, **12**, 21–2 (from *Plan. Khoz.*, May 1955).—During 1951–54 exploratory drilling was 5 times as large as in 1940. New methods of operation of wells brought production to 50–60% of total reservoir contents of crude, whilst the number of boreholes per given area fell 5–6 times. The yearly fall in production of existing wells is compensated by 10–20% of the new wells brought in. In 1955 81% of all the drilling was done using turbo-drill (23·7% in 1950). High-speed and pressure drilling were introduced at 450 derricks. Small dia bits weighing 63 tons and "Uralmach" drills weighing 133 tons are in use for exploratory drilling. New types of pipe are to be introduced. Natural gas production went up, but gas accompanying crude is burned in 4 cases out of 10. Some is converted into acetylene and formaldehyde, but on experimental scale only. Plans for distribution of gas by grid are hampered by shortage of steel. Refining has improved mostly in quality, and the proportion of "white" products rose by *ca* 15% from *ca* 40 to 55%. In drilling, a 20% increase in efficiency has been observed. Automation of producing wells is under consideration. M. S.

TRANSPORT AND STORAGE

1071. Cleaning tanks in tankers—the use of a revolving nozzle arrangement. A. G. Arend. *Petroleum, Lond.*, 1957, **20** (2), 66.—The author considers the advantages of the revolving nozzle arrangement and other devices to speed the operation and provide an efficient, quick, and safe method of cleaning. E. A. G. H.

1072. How to calculate liquid line capacity. J. M. Campbell. *Oil Gas J.*, 18.3.57, **55** (11), 132.—A chart and formulæ are given for the determination with a given pressure drop, and an example is worked out. G. A. C.

1073. How to get the most from your tank mixers. L. R. van Arsdale. *Pipe Line Ind.*, 1956, **5** (6), 17–19.—Key points of design, installation, and operating procedures of variable angle mixers are discussed, with supporting illustrations. Correctly installed and operated, the mixers eliminate the necessity for tank cleaning, provide well blended oil for refining, and are helpful in H_2O removal. R. T.

1074. The world tanker fleet. A. Little. *Petrol. Times*, 29.3.57, **61** (1556), 275.—A review of trends and problems is given, tanker financing and effects of taxation discussed, together with problems of manpower, impact of Suez Canal crisis, and tanker freight rates. G. A. C.

1075. How to calculate pipe diameter needed. J. M. Campbell. *Oil Gas J.*, 4.3.57, **55** (9), 112.—Chart and formulæ are given for determination of line dia for a given flow rate and pressure drop or for the capacity of a given size line under fixed pressure conditions. An example is worked out. G. A. C.

1076. A pipeline telecommunication system. A. W. Cole and I. O. Pilkington. *Petroleum, Lond.*, 1957, **20** (3), 87–90, 108.—In this paper, the problem is discussed with particular reference to the Trans-Iranian pipeline, where multi-channel radio equipment has been selected; the purpose is to link pumping stations along the line. A VHF band between 150 and 200 Mc/s has been chosen in view of the mountainous terrain. The sites for radio stations were based on survey work and subsequent testing, and each contains a tower supporting aerials pointing in each direction, radio transmitters and receivers for each direction in duplicate, and diesel generators in duplicate for electric power. In the interests of reliability, such things as high-power transmitting valves and rectifying valves have been omitted and alternative devices used. E. A. G. H.

1077. Middle East pipelines—present problems surveyed. T. H. H. Skeet. *Petroleum, Lond.*, 1957, **20** (3), 91–5.—The author reviews existing pipelines in this area and assesses the factors to be borne in mind with regard to future plans. Many major pipeline circuits were completed when tankers remained under 20,000 tons, but have always been prone to political instability effects, such as has been demonstrated recently in the case of Iraq lines passing through Syria and Lebanon. Mention is made of a projected line to the Turkish port of Iskenderun from Iraq running near the Syrian border, and plans for lines through Israel connecting the Red Sea to the Mediterranean. Much of the present insecurity is attributed to the failure of companies to adhere to the Red Line agreement of 1911. E. A. G. H.

1078. Pipeline construction technique—modern methods for Europe. D. J. Westall. *Petroleum, Lond.*, 1957, **20** (3), 96–8.—The special problems attached to pipelaying in heavily populated countries containing areas of private property are discussed; these include special excavation methods, pipeline lowering, backfilling testing, and land reinstatement. In general, cathodic protection is now applied to all such pipelines, either on land or under water. E. A. G. H.

1079. Water filters aid in pressure-testing a pipeline. L. Resen. *Oil Gas J.*, 11.3.57, **55** (10), 154.—Transcontinental Gas Pipeline Corpn have installed filters to clean water before use in hydrostatic tests, with a result that sediment removal allowed line to be cleaned by squeegees. G. A. C.

1080. Coal-tar enamels still rate high with pipeliners. S. D. Day. *Oil Gas J.*, 11.3.57, **55** (10), 57.—Use and advantages of coal tar enamels for protecting pipelines are discussed and coating precautions reviewed. Tables show recommended coatings for service underground and safe handling temp for coated structures. G. A. C.

1081. Banner year for new pipeline work seen by industry leaders. Anon. *Pipe Line News*, 1957, **29** (1), 41–8.D.—The construction work carried out during 1956 and the projects planned for 1957 by 32 American and Canadian firms are described individually. D. B. S.

1082. Gas industry to spend $1·954 billion for 1957 expansion. Anon. *Pipe Line News*, 1957, **29** (1), 19–20.—A review of developments in gas pipelines, storage pools, and proven reserves in the U.S.A. and Canada during 1956. 20,000 miles of main were laid, bringing the total to 517,000. Natural gas is now sold to 25,019,000 customers. Expansions planned for 1957 are described. D. B. S.

1083. America Louisiana pipeline. E. Sterrett. *Pipe Line News*, 1957, **29** (1), 21–40.—The construction and operation of this 30-inch line, 979 miles in length, which transports natural gas from the Gulf Coast to the Midwest, is described in detail. Throughput is 360 million cu. ft/day. D. B. S.

1084. New machine for pipeline river crossing. P. Reed. *Oil Gas J.*, 1.4.57, **55** (13), 206.—Western Construction Co have designed a machine for pipelining rivers, which uses pneumatic rock drills for shot-hole drilling from floating equipment. The work of crossing the Susquehanna River in the Delta Pa area is described. G. A. C.

1085. This record lets you see. J. A. Holloway. *Oil Gas J.*, 11.3.57, **55** (10), 170.—A pipeline maintenance record card developed by Houston Pipe Line Co is shown which presents all accumulated records in pictorial form. Details of leaks and their repairs, hot spot replacements, and data on anodes are easily seen from the card. G. A. C.

1086. Know-how paying off in laying 36-inch loops. Anon. *Pipe Line Ind.*, 1956, **5** (6), 10–16.—This highly illustrated article describes an improved method for laying 211 miles of 36-inch and 117 miles of 30-inch line. The pipe is coated internally with epoxy resin and dried with CH_3OH after hydraulic testing. Pipe is lowered into the ditch and coated in one operation. R. T.

1087. New barge takes weight coating to sea. R. C. Hughes, Jr. *Pipe Line Ind.*, 1956, **5** (6), 20–4.—A hot asphaltic mixture—with fibre glass reinforcement—is produced in a barge-mounted plant. The mixture—combined wt and protective coating—is extruded on to the pipe, which is lowered from the coating-barge. R. T.

1088. Tougher steel in mill for future pipelines. A. B. Wilder. *Pipe Line Ind.*, 1956, **5** (6), 24–9.—Tougher steels will be required for lines operated at sub-zero temp, near pumping stations, and in densely populated areas. An

investigation is reported on research on new steels re preheating conditions, properties, and welding characteristics. The importance of testing pipelines in the field is stressed. Properties and welding characteristics of new steels with 110,000 p.s.i. min yield strength are investigated. Low-alloy steels are compared with straight C-steels. Cracks are not encountered with low-H_2 electrodes. New manufacturing processes for double submerged arc-welded line pipe and large-dia seamless pipe are discussed. Causes of failures, and a new X-ray technique without a film, are described. R. T.

1089. Why Gulf Interstate is going to "satellites." R. Lo Chiano. *Pipe Line Ind.*, 1956, **5** (5), 34–8.—Successful operation of the Stanton, Kentucky, station from the master station at Clementsville, 90 miles away, sets the pattern for 4 stations now under construction. Economic factors affecting design and power units are discussed. Protection is provided by engine shutdown, alarm signals, turning on fire-fighting equipment, opening blowdown valve, etc. 3 fire protection systems are described. A gas snifter samples gas around danger areas. There are 52 safety devices on the one-unit compressor station, these—grouped into 3 classifications—alarm, shutdown restart, and shutdown lockout—constitute all the information telemetered. R. T.

1090. Cut calculating time with computers. G. V. Rohleder. *Pipe Line Ind.*, 1956, **5** (5), 39–42.—Design and functioning of the electronic computer—in many sizes and highly flexible—are discussed. Solutions to pipeline problems are more accurate, faster, and economical. The computer can add, subtract, multiply, divide, and make logical decisions. The solution of a typical pipeline problem is presented. R. T.

1091. Computer aids in gas pipeline design. H. E. Thomas. *Pipe Line Ind.*, 1956, **5** (5), 43–6.—El Paso Natural Gas Co uses a card-programmed computer to solve major pipeline design problems. Operation of the illustrated computer is described in detail. 3 major problems solved in one year are discussed. R. T.

1092. Select the correct electronic instrument. A. J. Hornfeck. *Pipe Line Ind.*, 1956, **5** (5), 51–5.—Conventional pneumatic systems used currently on long distance pipelines are being replaced by electrical measurements for data transmission and control. The systems—suitable for digital or analogue control—are explained and illustrated for application with d.c. or a.c. Advantages and limitations of electronic control are discussed. R. T.

1093. Why VHF system is used on Sui–Karachi line. Anon. *Pipe Line Ind.*, 1956, **5** (5), 58–60.—Selection of VHF radiotelephone system for the 16-inch, 350-miles, $150-million natural gas pipeline is influenced by cost, terrain, and excessive temp. R. T.

1094. "Sea Train" methods used to cross Corpus Christi Bay in five days. M. A. Judah. *Pipe Line Ind.*, 1956, **5** (4), 28–31.—Laying of 60,000 ft of concrete-coated submarine pipeline in 80 hr, in stormy weather, is described. The pipes, in 4000-ft welded sections, were towed into place and joined by over-water welding. R. T.

1095. Sifting backfill for profit. R. J. Titus. *Pipe Line Ind.*, 1956, **5** (4), 39–41.—Pipeline padding machines provide adequate protection at a cost of 10–20 cents/ft. Conventional methods cost 60–70 cents/ft. Rock shield and haulage of filler dirt are eliminated. Inadequate covering can lead to lower flow eff. R. T.

1096. Service's sooner microwave. B. Brock. *Pipe Line Ind.*, 1956, **5** (4), 42–4.—Design, construction, and functioning of Service Pipe Line Co's new microwave system in Oklahoma are described. The service—eliminating 121 miles of land line—makes possible remote control of El Reno station in Oklahoma from Monroe, Texas. A similar system spanning 158 miles is proposed for Missouri. The Service system, depending formerly on a 5000-mile land line system, carrying telephone and teletype signals and telemetering, will give shorter and more reliable communication. R. T.

1097. Pipelining behind the Iron Curtain. Anon. *Pipe Line Ind.*, 1956, **5** (4), 58–60.—Russia's sixth 5-year plan outlines a pipeline construction programme with total mileage *ca* 20,000. The plan calls for 3 times more oil production, and 4·5 times more gas vol to Moscow than in 1955, with a drop in coal from 8·6 million tons in 1955 to 990,000 tons in 1960. Gas will be distributed to twice as many homes, and 6·5 times more light ends and liq gas production are called for. Pipelines and oilfields are shown on a map. R. T.

1098. Economic aspect of packing in distribution of petroleum products. P. Lipka. *Nafta (Krakow)*, 1956, **12**, 47–9.—Permanent packages should not be retained unnecessarily by the consumers, and should be returned in good condition for re-use. Package should be appropriate to the contents and used preferably for the same product throughout its life. The Central Office for Petroleum published a decree covering that aspect dividing packings into: (1) permanent, which are always the property of the producer and loaned to the consumer, *e.g.* steel drums and high-pressure steel bottles; (2) semi-permanent, which can be sold, *e.g.* kegs; (3) tins and boxes whether of cardboard or metal. Salvaged packing should be returned to the supplier at an agreed price or to the respective central collecting agency. M. S.

1099. 15 of 17 welders flunked tests. J. Hinkel. *Oil Gas J.*, 11.3.57, **55** (10), 136.—Use of high-tensile steels makes it necessary to modify the weld test requirements and also welding procedures, and modifications are shown in API Standard 1104, Third Edition, March 1955. G. A. C.

1100. Loudden oil harbour. Anon. *Petrol. Times*, 29.3.57, **61** (1556), 281.—Developments are described at the principal Swedish oil port, and include underground cisterns for storage of petrol, laying a pier with berths for 2 ocean-going vessels, and an eventual provision of a plant for receiving and purifying oil-containing water from ships. G. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1101. Survey of new refinery construction. Anon. *Oil Gas J.*, 25.3.57, **55** (12), 204.—Increases, especially in reforming, alkylation, and hydrogen treating, are deduced from project-by-project details of new refineries in the U.S.A. Accent is on increased quality rather than increased throughput. G. A. C.

1102. The use of the heat pump in distillation. D. Hijman and J. C. Norenburg. *Ingenieur, 's Grav.*, 16.11.56, **68** (46), Ch. 73–8.—After a brief description of the principle illustrated by the *S–T* diagram the author discusses possible applications in dist processes. A list is given of 8 conditions that have to be fulfilled to make the process economically justifiable. Under these conditions an appreciable saving can be made in spite of the higher capital investment. A possible net saving of £43,000 p.a. could be obtained for a pentane–*iso*pentane splitter with a throughput of 300 tons/day. 12 figs. G. F. T. C.

1103. Symposium on coolers and condensers. VII. Plate-coolers. T. M. Reichert. *Ingenieur, 's Grav.*, 12.10.56, **68** (41), Ch. 61–9.—A survey is given of the considerations lead-

ing to the choice of plate-coolers. In the case of stainless steel the use of sheets instead of tubes results in reduced investment costs. Construction and calculation of 2 types, *i.e.* a liq cooler with external coolant and a gas cooler with internal coolant, are discussed in detail. 9 figs.

G. F. T. C.

1104. Using electronic computers in the oil industry. R. L. McIntire. *Oil Gas J.*, 4.3.57, **55** (9), 122.—Methods are given for organizing and using design data in connexion with the use of automatic computers for process design. G. A. C.

1105. Esso designs to eliminate need for explosion proof motors. E. Talley. *Oil Gas J.*, 18.3.57, **55** (11), 128.—Past practice and changes in practice are reviewed. Operating of from 200- to 900-h.p. weather-protected electric motors in open areas of refinery tank fields, compressor and blower drivers, and possible future use of drip-proof motors in outdoor service by application of moisture-resistant insulation are discussed. G. A. C.

1106. How to design stable compressor foundations. T. L. Novosad. *Oil Gas J.*, 11.3.57, **55** (10), 129.—A study is given of a foundation failure in a compressor station in the Mississippi River alluvial basin and of methods employed to solve the problem. Soil dynamics should be carefully considered and engine unbalance investigated, and more accurate methods are needed to define conditions that cause vibrations.

G. A. C.

1107. 48 selected plant processes. Anon. *Oil Gas J.*, 25.3.57, **55** (12), 121.—Flow sheets and flow descriptions are given for 48 selected refinery processes, including coking, cracking, platforming, hydrogenation, isomerization, alkylation, and urea dewaxing. G. A. C.

1108. Radiation processing. H. J. Ogorzaly, H. Burton, *et al. Oil Gas J.*, 25.3.57, **55** (12), 213.—8 authorities summarize present position and future possibilities in radiation processes. Immediate changes in process industry are not anticipated, and the processes will be of practical value only if radiation-induced reactions lead to a less expensive product. G. A. C.

1109. Effect of high temperature on some properties of heat-exchanger oils. A. Groszek. *Benzole Producers Ltd Research Paper* 2, 1957.—An investigation of the deterioration at 300° C of mineral oils used as heat-exchange media. Using special apparatus, oil heated to 300° C was circulated and a steel plate moved in and out of the oil for 7½-hr periods. Tendency to form sludge and oxidn products was estimated from visc changes and by chromatographic behaviour.

Corrosion of steel in contact with hot oil was estimated from amount of deposits on the plate. The effect of additives on one oil was examined. G. S.

1110. The growth of a refinery—Pernis, the plant built on polders. Anon. *Petroleum, Lond.*, 1957, **20** (1), 11–12, 25.—A short history of the erection of the new refinery from existing plants is described. There follow a number of statistics relating to the present capacity, while dist and cracking methods are reviewed in addition. E. A. G. H.

DISTILLATION

1111. How to stretch your equilibrium data. II. J. O. Osburn. *Chem. Engng*, 1957, **64** (2), 270–8.—A method is given for calculating equilibrium data from b.p. measurements. The assumptions necessary and the accuracy of the method are discussed. The self-consistency of data can be tested thermodynamically. D. H. A.

1112. New asphalt plant charges Boscan crude. L. Resen. *Oil Gas J.*, 1.4.57, **53** (13), 201.—Plant of Texas Asphalt and Refinery Co on Houston Ship Channel processes 5000 b.d. of low-gravity Boscan crude from Venezuela. Tables show analyses of crude used and typical yields. G. A. C.

SOLVENT EXTRACTION AND DEWAXING

1113. Some aspects of the manufacture of solvents based on petroleum. T. F. Risselade and H. Verschoor. *Ingenieur, 's Grav.*, 21.12.56, **68** (51), Ch. 81–5.—A survey is given of the growth of petroleum chemicals production during the past 25 years in the U.S.A. and W. Europe. Particular reference is made to the manufacture of *iso*propyl alcohol and acetone from propene by the sulphuric acid process. Various processes for reconcentrating and decarbonizing the spent acid are discussed. 3 figs, 4 tables, 15 refs. G. F. T. C.

1114. Barisol dewaxing of heavy paraffin oils. P. Biega. *Nafta* (*Krakow*), 1956, **12**, 17–19.—The fractionating column delivers 2 cuts containing respectively 8–15 and 12–18% wax, the first used to be filtered directly, and the second split into 2 fractions, of which the first was filtered and the second used to be subjected to destructive dist. Now the second cut is refined with dichloroethane with 18–22% benzole, *i.e.* by the Barisol process. This is described in fair detail and also the details of products are given: the lubricant contains less than 10% of wax and the petrolatum *ca* 75% of it. The oil is refined with cresol and then with 4% H_2SO_4. M. S.

1115. Study of urea-reaction for dewaxing of washed blue oil from Indian crude oil. K. V. Gopalan. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 155–67.—Experiments on dewaxing washed blue oil (W.B.O.) from an Indian crude are described. Results show that the crit max temp for the urea reaction with W.B.O. is governed by the urea concn in aq soln, higher strength favouring a higher max temp. It may be stated generally that the max reaction temp is not much higher than the urea saturation temp of the reacting soln. Under optimum conditions W.B.O. can be separated or dewaxed by urea soln into 12–14 wt % waxy material with a drop set pt *ca* 90° F, and 86–88 wt % of low cold test lub base with f.p. approx 15° F. Urea crystals react with W.B.O. under ideal temp and reaction conditions, but—for identical results—the reaction is slower. The reaction with urea crystals may clarify the mechanism of the urea reaction with straight-chain hydrocarbons. Results of W.B.O. dewaxing with urea soln and M.E.K. are compared. Dist fractions from dewaxed blue oils were examined for the effect of dewaxing on the cold test, visc, and V.I. for each series. Results show that urea dewaxes the lighter fractions of W.B.O. more; M.E.K. dewaxes the heavier fractions better. A disadvantage of the urea process seems to be that intermediate adduct crystals = *ca* 100–200 wt % on W.B.O., and that filtration, washing, decomp, extraction, and dist stages would call for large component units. It appears that the saving in refrigeration costs which the urea process can effect will be nullified completely, even exceeded, by the higher costs of other process operations. R. T.

CRACKING

1116. Hydrocarbon conversion in pyrometer-controlled cyclic generator (MS 17). J. Reboul and P. Gross. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1573–99.—Equipment designed for production from refinery gas (from Mobil's Frontignan refinery) of gas interchangeable with town gas and having a cal val of 4200–4800 cal/m³. Plant is capable of operating on LPG when refinery is shut down. Cycle is: heat, steam purge, gas + steam + air, steam purge. Purge steam can

convert any C on cat into water gas. Control is automatic, based on temp in cat (Ni) bed in reactor. Description of equipment, including especially control side, flow diagram, photos. Plant capacity is approx 220 m^3 (NTP)/hr, yield *ca* 85% (plant producing its own steam). Detailed results, including heat balances, are given for both refinery gas and butane operation. Equipment is very flexible and can yield gas of widely varying quality. V. B.

1117. Cat reformer gets an acid bath. D. M. O'Neill. *Oil Gas J.*, 11.3.57, **55** (10), 183.—Experience is given of Standard Oil Co, El Paso, Texas, in removal of iron sulphide scale from a 5000-b.d. platinum-cat cat reforming unit with hydrochloric acid. Safe disposal of 80,000 cu. ft. of H_2S generated in cleaning was accomplished; working recommendations are made for future cleaning operations. G. A. C.

1118. Catalysis Congress at Philadelphia. R. W. Cranston. *Petroleum, Lond.*, 1956, **19** (12), 443–4.—A short outline of the subjects discussed at the Congress is given, stress being put on the study of cat by deuterium exchange reactions, i.r. methods, and chromatography. E. A. G. H.

HYDROGENATION

1119. New palladium catalyst for the dehydrogenation of 6-carbon-atom cyclanes. N. I. Chouikine and Kh.M. Minatchev. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1611–15.—Cat (containing 0·5% Pd) prepared by ppting hydrated Al_2O_3 from aluminium nitrate soln by 12% NH_3 soln, drying, treating with HF, roasting, impregnating with palladium chloride, and treating with H_2S. Tests (450°–460° C, 20 atm H_2, space velocity 1 litre per litre cat/hr) on dehydrogenation of 98°–109° C cut containing 7·5% aromatics raised aromatic content to 36–40%, cat activity substantially unchanged after 262 hr. Issuing gas contains 99% H_2, indicating absence of cracking; suggested that Pd could replace Pt in cat reforming processes. V. B.

POLYMERIZATION

1120. Achievements of industrial chemistry—hydrocarbon macromolecules. C. W. Bunn. *Chem. & Ind.*, 1957, 404–10.—Review of developments over the past 25 years, covering natural rubber, synthetic rubbers (GR-S and butyl), polythene, and polystyrene. The recent discovery of stereospecific polymerization, leading to the synthesis of polyisoprene identical with natural rubber, is discussed. W. A. M.

1121. Polymerization of light hydrocarbons—recent progress in refinery processes. 1. P. W. Sherwood. *Petroleum, Lond.*, 1957, **20** (2), 56–8.—Initially the stature of the polymerization process in petroleum refining is discussed. In a more detailed examination of polymerization, confined to the lower olefins yielding hydrocarbons up to C_{12}, the chief points illuminated are: (1) better operating conditions over solid phosphoric acid-type cat (including copper pyrophosphate); (2) the use of liq phosphoric acid and choice of operating conditions in its presence; (3) new cat, nickel oxide–silica–alumina type and silicotungstic acid type. E. A. G. H.

1122. Thermal polymerization of ethylene—studies at high pressures. S. K. Battacharyya and M. Shamaiengar. *Petroleum, Lond.*, 1956, **19** (11), 435–8.—Ethylene polymerization by non-cat thermal methods yields a product which can be fractionated to give gasoline, fuel oil, etc. In this paper temp between 295° and 410° C and a pressure range 2400–7400 p.s.i. were employed. Gaseous products were analysed: (1) unsaturated hydrocarbons by absorption in sulphuric acid of different strengths; (2) saturated hydrocarbons and hydrogen by combustion, and the liquid polymers according to ASTM specifications.

The optimum temp was found to be *ca* 380° C, while pressures over 5400 were not advantageous. In terms of particular polymer requirements, optimum temp ranges were evaluated. E. A. G. H.

ALKYLATION

1123. Blitzing alkylation problems: operating the fractionation system. Anon. *Oil Gas J.*, 18.3.57, **55** (11), 110.—This is the first of 6 articles, and deals with control of *iso*butane from de*iso*butanizer, improved de*iso*butane operation, obtaining depropanized feedstock, and control of temp on re-run boilers; the problems being discussed and answers given. G. A. C.

CHEMICAL AND PHYSICAL REFINING

1124. Extraction-, adsorption-, and thermal-sweetening processes without hydrogen. (In German.) P. W. Sherwood. *Erdöl u. Kohle*, 1956, **9**, 308–10.—Extraction with NaOH or KOH soln—the basis of many extraction processes—is discussed. Pressure, temp, and alkali concn are important. Mercaptan removal is increased by addn of org promoters. Processes discussed are the Solutizer, Tannin Solutizer, Mercapsol, Unisol, Standard, and Dualayer. The Tide Water Associated Oil Co introduced use of inhibitors, *i.e.* addn o phenyldiamine to the acid hydrocarbon and a wash with NaOH, with practically complete mercaptan removal. Alkali regeneration is discussed. 2 adsorption processes are discussed. The Continental Oil Co passes acid cracked dist through activated C impregnated with doctor test soln, with pptn and adsorption of Pb mercaptides in the solid phase. The second process separates mercaptans from acid benzine over activated C impregnated with medium-strength, *i.e.* 20%, alkali solution. In thermal processes—practically limited to light dist—the vaporized material is passed over heated Al–Si cat; removal of mercaptans, and improved O.N. and lead sensitivity result. Other processes discussed are the Perco, using activated Al cat, and the Houdry, using cat consisting of acid-containing clay + oxides of heavy metals at 310°–320° C. 10 refs. R. T.

SPECIAL PROCESSES

1125. Dehydrogenation of secondary alcohols: the elements of the rational calculation of an industrial reactor. F. Coussemant. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 261–70.—The dehydrogenation of secondary alcohols has led to research and industrial operations for producing the corresponding ketones. The conventional method is by reaction in the gas phase at 400°–450° C on cat, *e.g.* ZnO. These conditions are a thermodynamic necessity, high temp being required to achieve a satisfactory reaction equilibrium. This thermodynamic necessity can be sidetracked by eliminating one of the products (H_2), thus displacing the equilibrium. A liq-phase process must be adopted to make this elimination practically automatic. Lab studies have shown that the difficulty lies in the kinetics of the reaction, and that the reaction is inhibited by the other product, the ketone formed. Thus it was possible to determine the law governing this reaction, to figure out the parameters on which it depends and their variation with the temp, and the different possible couples of secondary alcohols–ketones. Following these studies, the Institut Français du Pétrole has developed an industrial process for the dehydrogenation of secondary alcohols which can be employed for manufacturing all kinds

of ketones. It is a liq-phase process carried out at *ca* 150° C, and free from marginal reactions, so that the output is practically 100%. Other advantages of this process are: its very simple equipment, involving small capital investment, extremely small personnel required for manufacturing and maintenance purposes, low consumption of heat and mechanical power. A semi-industrial continuous cycle ketone production plant is now operating at the Institut Français du Pétrole. An industrial plant has been built and has been in operation for *ca* one year. The lab research work and advantages listed above have thus been confirmed in practice.
R. T.

1126. Raising the output of styrene—new unit in operation at Grangemouth. Anon. *Petroleum, Lond.*, 1957, **20** (1), 13.—A brief description of the manufacturing process is given, together with certain information on unit layout.
E. A. G. H.

1127. Processes for *iso*butane production. P. W. Sherwood. *Petroleum, Lond.*, 1956, **19** (11), 393–6, 410.—These are important from the viewpoint of supplementing the supply obtainable from certain refinery gases, special mention being made of methods of obtaining favourable low-temp equilibrium in the system *iso*butane–*n*-butane. The two main vapour-phase isomerization processes, "Isocel" being one, both use aluminium chloride on a bauxite carrier, but the alternative method features continuous refortification of cat, permitting longer on-stream life. Reaction variables mainly controlling vapour-phase methods are HCl concn, temp, pressure, and space velocity. By comparison liq phase processes gain chiefly in avoidance of periodic shutdowns for cat replacement, as well as lesser sensitivity to cat poisons. The major processes of this type are the U.O.P., Standard, and Antimony Chloride. U.O.P. and Standard both employ aluminium chloride as cat and HCl as promoter, but differ as to the method of introducing HCl, whereas in the third, antimony trichloride is present in addition, playing no part in the actual cat, but producing other favourable results.
E. A. G. H.

METERING AND CONTROL

1128. 140 million brl of crude measured by P.D. meters. D. C. McKinley. *Pipe Line Ind.*, 1956, **5** (4), 32–7.—Operation and advantages of positive displacement (P.D.) meters are discussed. Over 140 million brl of crude oil have been metered at Interstate Pipe Line Co's terminals with highly successful maintenance and operating record.
R. T.

1129. Computers for the petroleum industry. Various. *Petroleum, Lond.*, 1957, **20** (1), 21–6.—Summaries of 4 papers are given: Process Development in the Petroleum Industry, by J. T. Ahlin; The Application of a Computer to Refinery Problems, by B. D. Dagnall and P. Mayers; Computing Facilities in Great Britain, by J. H. Wilkinson; and Fundamental Research in the Petroleum Industry by M. P. Barnett.
E. A. G. H.

1130. Cost of pneumatic control systems. E. L. Thomas. *Oil Gas J.*, 18.3.57, **55** (11), 113.—From the experience of Carbide and Carbon Chemicals Co, typical overall costs of pneumatic control systems have been determined from the development of a unit cost system.

Control room, panels process leads to instruments, installation tubing pressure instruments, and maintenance are all costed, and tables give costs from 3 different systems.
G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

1131. Solubility of water in insulating oils. R. A. Lipshtein and E. N. Shtern. *Khim. i Tekh. Topliva*, 1956, (11), 46–54.—Relationship between H_2O content of oil and atm humidity is discussed and expression therefor, based on Henry's law, derived. 3 transformer oils (d_4^{20} 0·877–0·894, mol. wt. 250–280, $\%C_A$ 3–17) were tested for H_2O content at 20° C and varying atm humidity using CaH_2 method. At 100% atm humidity H_2O content was 30–50 p.p.m., increasing with increasing aromaticity and linearly with atm humidity. Effect of various polar additives (metallic naphthenates, etc.) on H_2O content of oils is shown, effect of Na naphthenate is very marked (0·01% can increase max H_2O sol 2·6 times), indicating need for care in refining to eliminate this material.
V. B.

1132. Electrode area effect for the impulse breakdown of transformer oil. H. S. Endicott and K. H. Weber. *Trans. Amer. Inst. Elect. Eng.*, 1957, Paper No. 118, 11 pp.—Tests made with 4 sets of Rogowski electrodes (spacing 0·075 inch) of differing areas (ratio 25 : 1) showed decrease of impulse breakdown (152–138 kV) with increasing electrode area; decrease, expressible by same area effect equation, is also found (43–39 kV) with 60 cycle tests (*cf. Power App. & Systems*, 1956, 371). 2 oils were examined having air contents of 1 and 9% (unchanged after test), water content increased slightly (on average from 11 to 18 p.p.m.).
V. B.

1133. Synthesis of cyclanic and arylaliphatic hydrocarbons; their viscosity and freezing points. A. D. Petrov. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1600–10.—Numerous newly-prepared polycyclic hydrocarbons are listed, with discussion of visc (in range 4–2000 cS/50° C) and solidification (m.p. up to 153° C). Visc increases with No. of rings; in structures of the type of tri- and tetra-substituted methanes freezing point can decrease with increase of mol. wt. A distinction is made between cryst and vitreous solidification, in case of latter visc anomaly (rise in visc, fall in V.I.) occurs. Wide variation in visc is observed only at temp relatively close to freezing point, with increasing divergence therefrom visc of various types of hydrocarbon tend to approach one another (*cf.* Abs. **696**, 1957).
V. B.

1134. Separation of saturated hydrocarbons from aromatic hydrocarbons. J. G. Waller. *Benzole Producers Ltd Research Paper* 3, 1957.—A review of methods for the removal of saturated hydrocarbons from benzole fractions. It is concluded that azeotropic dist is the process most suitable for use in the benzole industry, with extractive dist as the second choice.
G. S.

ANALYSIS AND TESTING

1135. Fuel spray investigations at Cranfield. E. M. Goodger. *Petroleum, Lond.*, 1956, **19** (11), 387–92.—The fundamental processes in spray formation are initially discussed and then an outline of work conducted at Cranfield is mentioned under the headings of educational, maintenance, and experimental. There follows the working arrangement of the test fuel rig with provision for measuring devices and methods of analysis. Among the major conclusions derived were: (1) the mechanism of the production of spray droplets is reasonably well established; (2) further information is required on the heat and mass transfer processes controlling the vaporization rate of droplets in a spray and on the movement of droplets within the region of stabilized flames.
E. A. G. H.

1136. Research on motor fuels. Anon. *Petroleum, Lond.*, 1957, **20** (1), 19–20, 26.—The main equipment available at the new engine test lab at Sunbury is listed and includes: (1) test engines for anti-knock rating determinations; (2) engine test beds for research on automotive engines; (3) a vehicle dynamometer for testing cars at loads and speeds under controlled temp and humidity; and (4) a tractor dynamometer for service testing of agricultural tractors.
E. A. G. H.

1137. Spinning band distillation column. M. Rousseau. *Chim. anal.*, 1957, **39**, 94–101.—A brief discussion of dist columns, followed by a review of dynamic types. A description of adiabatic spinning band (max 3500 rev/min) lab column 1 m high suitable for super-fract (max temp 200° C) of samples down to 5 ml, operable at 5–760 mm. Tests with methyl*cyclo*hexane/*n*-heptane show 33 theoret plates. Results are given for benzene (showing impurities present) and gasoline containing 5% benzene and 5% toluene (showing azeotrope formation) (*cf.* Abs. **1408**, 1953). V. B.

1138. Detection of traces of active sulphur in solvents. M. Huber. *Schweiz. Arch. angew. Wiss.*, 1957, **23**, 95.—Ag test, more sensitive than Cu strip, carried out on Ag sheet 1 mm thick in which an indentation 30 mm dia, 5 mm deep has been made. Test solvent is slowly introduced from a burette (avoid stopcock lubricants) whose tip is 1 mm from bottom of indentation. 5 ml solvent is used, feed rate is such that 1–2 drops are permanently present on strip, which is maintained at few ° C below b.p. of solvent. Test duration *ca* 40 minutes, sensitivity can be improved by using greater solvent vol. Materials giving neg Cu test can cause darkening of Ag.
V. B.

1139. The determination of mono- and di-aromatics in mineral oil fractions. H. Geelen, H. I. Waterman, and J. B. Westerdijk. *J. Inst. Petrol.*, 1957, **43** (397), 14–20.—A method for the calculation of the average number of mono-aromatic, di-aromatic, and naphthenic rings in oil fractions is described. It is based on the application of the diagrams relating specific refraction, specific vol, and percentage hydrogen with mol. wt. of saturated fractions to aromatic fractions. From this an apparent ring number is found, and equations are given from which the average number of rings can be calculated. Also formulæ are given which enable the average number of rings to be calculated directly from specific refraction, specific vol, and mol. wt. The method is applied to the analytical hydrogenation of fractions and to type concentrates, and results are compared with those from the *n–d–M* method. 6 refs. C. B.

1140. Some recent developments in the specification and testing of gear oils. A. Towle. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 169–86.—The ever-growing tendency towards transmitting greater power through mechanism of smaller unit size throws an increased responsibility on the lubricant to cope with the greater surface loading, and often also greatly increased sliding velocities. Mineral lub oils alone cannot in many cases hope to deal with this problem, which can be met only by blending into the lubricant chemical additives. The problem then remains of specifying and testing the compounded lubricant to be used for any particular application. Chemical and physical specifications by themselves have long been proved to be useless, and in the case of crankcase oils the answer has been found to lie in a specification based on lubricant performance in certain engine tests. This specification is now almost universally adopted by the armed forces of the N. Atlantic Treaty powers, as well as by a considerable body of commercial users and manufacturers. At first sight it might seem easier to specify and test a gear lubricant than a crankcase lubricant, but experience of the American oil industry over many years has conclusively shown that gear lubricants can be tested only in their full-scale applications and that there are 2 distinct conditions to satisfy, *i.e.* a high-torque, low-speed condition, where gear failure is by surface deformation or rippling, and a high-speed condition, where failure is by actual "pick-up" or scuffing between the mating surfaces. Each condition requires completely different properties from the oil, and the 2 are not necessarily compatible. As a result of this experience, there is in the U.S.A. an Ordnance Specification for "Universal" or "Multi-Purpose" gear lubricants, based on the satisfactory performance of an oil on 2 full-scale axle tests. Such oils are "satisfactory for the lubrication of automotive gear units, heavy-duty industrial type enclosed units, steering gears, etc." This paper traces the development of a British Specification No. CS. 2758, which uses British components for full-scale tests and which is accepted by American Army Ordnance as being of equivalent quality level to their own MIL-L-2105 Universal Gear Lubricant Specification. The paper shows how impossible it is to judge from results obtained on many of the most commonly used lab small-scale test machines whether or not an oil is likely to prove satisfactory in service. Additive depletion has long been a topic for discussion when considering the use of treated oils, and the author shows the influence of additive depletion with running time on the load-carrying capacity of a "multi-purpose" sulphur–chlorine–phosphorus gear lubricant with respect to both new and run-in gears. The conclusion is drawn that the effective load capacity of the gear and lubricant combination is not lowered by any additive depletion which may take place during, say, 10,000 miles of passenger car operation. (Author's abstract.)

1141. Determination of combined chloride in hydrocarbon mixtures. J. Pentelow and A. Durham. *Benzole Producers Ltd Research Paper* 1, 1957.—A polarographic method for determining combined chlorine in hydrocarbon samples which is satisfactory for concn in the range 0·0001–5% w/w.
G. S.

1142. Testing the electric strength of liquid dielectric or insulating material. J. A. Kok and M. M. G. Corbey. *Appl. Sci. Res. B*, 1956, **6**, 285–95.—Considerable evidence is available (previous work reviewed) that electric breakdown strength of oil depends on minute contaminants not removable by ordinary filtration and which form a conducting bridge. Size order of such particles is 20 A (*i.e.* comparable with the length of elementary cellulose cells). Relationship between breakdown strength, time-lag thereof, and particle size and concn is discussed. The effect of pre-breakdown discharge is to decrease the short-time (microsec) electric strength and to increase the long-time value. The short-time electric strength may be considered as the intrinsic electric strength of the material, of ionic (not electronic) origin. Tests on 2 commercial transformer oils (using 20 mm rad spherical segment electrodes spaced at 1·4–2 mm) showed that breakdown strength (1 hr) could be raised from 11–19 kV/mm to 40–68 kV/mm by passing through a Cottrell electrostatic filter. V. B.

1143. Determination of the surface tension of mineral oil fractions by means of their kinematic viscosity, refractive index, and density, using the spatial *ν*, *n*, d, model. J. Cornelissen, O. Harva, and H. I. Waterman. *Chim. et Industr*, 1957, **77**, 533–9.—Spatial model previously described (*cf.* Abs. **699**, 1957) is used to yield surfaces of equal σ_{20}, from which 5 diagrams are derived (one for each of the values of log ν_{20} of 0·3, 0·5, 1·0, 1·5, 2·0) on which σ_{20} (overall range 25·8–32·8 dynes/cm) is shown on co-ordinates of n_D^{20} and d_4^{20}; values for cuts of intermediate visc are obtained by interpolation. Comparisons of large number of determined and

calc values of σ_{20} shows, in general, agreement within limits ($\pm$0·2 dynes/cm) of exptl error. Any excessive divergence indicates contamination of the oil fraction. V. B.

1144. Hydrocarbons in the 116° to 126° C fraction of petroleum. A. R. Glasgow, Jr. *et al.* *Analyt. Chem.*, 1957, **29**, 357–60.—22 hydrocarbons were found in the fraction of petroleum boiling between 116° and 126° C which represents 5·37% by vol of the original petroleum. These cpds were concentrated by fractionating processes of regular and azeotropic dist and identified by i.r. and mass spectrometric method together with measurement of the simple physical properties. J. S.

1145. Determination of trace amounts of arsenic in petroleum distillates. N. C. Maranowski, R. E. Snyder, and R. O. Clark. *Analyt. Chem.*, 1957, **29**, 353–7.—Arsenic in petroleum fractions in concn as low as 1 part per billion can be determined by a reflectometric method. The method depends on wet oxidn of the sample followed by a modified Gutzeit test. Intensity of the stain on paper from the reaction of arsine and mercuric bromide is measured with a spectrophotometer equipped with a diffuse reflectance attachment. Recoveries of 90% or better are obtained on samples containing from 0·1 to 0·5 γ of arsenic, and the standard deviation is within the range 0·020–0·025 γ of arsenic. Interference by most of the common metals except antimony above 100 γ did not present any difficulty. J. S.

1146. Determination of trace amounts of chlorine in naphtha. J. G. Bergmann and J. Sanik, Jr. *Analyt. Chem.*, 1957, **29**, 241–3.—A method has been developed for determining less than 10 p.p.m. of chlorine in naphthas. The organic chlorine is converted into chloride ion either by the lamp combustion method or sodium biphenyl reduction, although lamp combustion is preferred for most naphthas. The chloride ion is determined colorimetrically by using mercuric thiocyanate and ferric iron. The method has an accuracy of 0·1 p.p.m., and an analysis can be completed in 3 hr. J. S.

1147. Determination of organically bound chlorine in petroleum fractions with oxyhydrogen burner. L. Granatelli. *Analyt. Chem.*, 1957, **29**, 238–41.—Organically bound chlorine in petroleum fractions is converted to hydrogen chloride by combustion of the sample in the flame of a Beckmann oxyhydrogen burner. Products of combustion are absorbed in demineralized water and the chloride determined by titration potentiometrically with silver nitrate soln. The method of combustion is rapid, burning rate being *ca* 30 ml/hr. Concn below 100 p.p.m. can be determined with a standard deviation of 2 p.p.m. J. S.

1148. Polarographic determination of antioxidants in gasoline. V. F. Gaylor, A. L. Conrad, and J. H. Landerl. *Analyt. Chem.*, 1957, **29**, 228–31.—A polarographic method for the direct determination of antioxidants in gasoline is based upon measurement of the oxidn waves produced at a wax-impregnated graphite electrode. Lithium chloride in *iso*propyl alcohol is used as the solvent electrolyte. Analysis is conducted directly on an alcoholic soln of the sample, thus eliminating the time-consuming extraction step. The method has been applied to the determination of 2 commercial antioxidants, N,N′-di-*sec*-butyl-*p*-phenylenediamine and N-N-butyl-aminophenol. A single sample can be analysed in approx 30–45 minutes. Standard deviation of the method is approx 9%. Concn as low as 2 p.p.m. in the gasoline can be determined. J. S.

1149. Determination of trace amounts of lead in gasolines and naphthas. M. E. Griffing and A. Rozek. *Analyt. Chem.*, 1957, **29**, 190–5.—2 analytical methods have been developed for the determination of lead in gasolines and naphthas in the concentration range of 10–100 parts per billion of lead as inorganic lead or TEL. Both methods are modifications of the dithizone colorimetric procedures. One is a spectrophotometric method which involves extraction of the lead at pH 9·5–10·5, and the other is a colour comparator method which involves the extraction of lead at pH 10·8–11·0. The latter method is suitable for field use and requires only 10 minutes/sample. The accuracy and precision of the methods are within 10 parts per billion. J. S.

1150. Determination of trace amounts of carbon monoxide in gaseous hydrocarbons. K. H. Nelson, M. D. Grimes, D. E. Smith, and B. J. Heinrich. *Analyt. Chem.*, 1957, **29**, 180–3.—A method for the determination of 0–100 p.p.m. of carbon monoxide in saturated and unsaturated hydrocarbon gases is based on the reaction of carbon monoxide in methane with heated iodine pentoxide to form iodine and carbon dioxide. Methane does not react with iodine pentoxide, but other hydrocarbons do react. Methane is first added to the sample. Low-temp fractional dist removes the carbon monoxide from the sample and concentrates it in the methane fraction. The mixture is passed through a tube filled with activated charcoal to remove traces of other hydrocarbons, then through a drying tube to remove moisture, and finally through a heated combustion tube filled with alternate layers of iodine pentoxide and glass wool. The liberated iodine is collected in a potassium iodide soln and measured spectrophotometrically. In the range of 0–100 p.p.m. the accuracy is within 1–2 p.p.m. J. S.

1151. Determination of trace amounts of total nitrogen in petroleum distillates. G. R. Bond, Jr. and C. G. Harriz. *Analyt. Chem.*, 1957, **29**, 177–80.—Trace quantities of nitrogen cpds are known to poison hydrocarbon conversion cat and their determination at these low concn presents a serious analytical problem. Such nitrogen cpds may be adsorbed from large hydrocarbon samples on to a small silica gel column. This column is then broken into a standard Kjeldahl flask, digested, and the determination completed in the usual manner. It is necessary to take precautions against bumping during the digestion. Nitrogen contents as low as 1 p.p.m. can be determined by using a one-litre sample, and results are accurate to within 5% of the nitrogen present in the 1–10 p.p.m. range. J. S.

1152. Purification, purity, and freezing point of 20 API Standard and API Research hydrocarbons. A. T. Streiff *et al.* *Analyt. Chem.*, 1957, **29**, 361–4.—Purification and determination of freezing points and purity are described for 20 hydrocarbons of the API Standard and API Research Series. J. S.

1153. Separation of the C_{18} to C_{25} fraction of petroleum. B. J. Mair, W. J. Marculaitis, and F. D. Rossini. *Analyt. Chem.*, 1957, **29**, 92–100.—The heavy gas oil and light lub oil fraction, C_{18} to C_{25}, of petroleum was separated by adsorption with silica-gel to give a paraffin–*cyclo*paraffin portion, an aromatic portion, and a small residue comprising non-hydrocarbon components. The aromatic portion was further separated by adsorption with alumina to give mononuclear, dinuclear, and trinuclear aromatic portions; the paraffin–*cyclo*paraffin portion was fractionated by treatment with urea to give a portion containing *n*-paraffins and branched paraffins plus *cyclo*paraffins. The portion containing the *n*-paraffins was fractionated by dist at very low pressure to give concentrates of the individual *n*-paraffins. The *n*-paraffins were purified by crystallization to give individual *n*-paraffins C_{18} to C_{24}. Taking the C_{18} to C_{25} fraction as 100%, the relative amounts of the several types of hydrocarbons separated from this fraction of petroleum are in percentage by vol: total aromatics 25·5%, mononuclear aromatics 12·2%, dinuclear aromatics 7·9%, trinuclear aromatics 5·1%, *n*-

paraffins 17·1%, branched paraffins and *cyclo*paraffins 56·3%, residue 1·4%. J. S.

1154. Determination of copper in fuel oil and other petroleum products. D. M. Zall, R. E. McMichael, and D. W. Fisher. *Analyt. Chem.*, 1957, **29**, 88–90.—An accurate and simple spectrophotometric method for the determination of copper in petroleum products uses neocuproine (2,9-dimethyl-1,10-phenanthroline) for the development of the copper–neocuproine complex which has a max absorbance at 450 mμ.

A suitable sized sample of the fuel is measured into a 25-ml volumetric flask, to which is added 10 ml of the neocuproine soln (1 g of 2,9-dimethyl-1,10-phenanthroline and 1 g of hydroquinone in 1 litre of *iso*propyl alcohol). Make up to the mark with chloroform, mix thoroughly, and allow to stand for *ca* ½ hr. The blank consists of 10 ml of reagent diluted to 25 ml with chloroform. The transmittance is measured at 454 mμ, and the copper content is determined by referring to a standard calibration curve. The advantages of the method are: no ashing or acid extraction, no acid dissolution of the ash, no buffering or chelating, no pH adjustment, and no extraction. A single copper sample can be determined in less than 1 hr, and results compare favourably with other chemical and physical methods. J. S.

1155. Potentiometric determination of mercaptans in the presence of elemental sulphur. J. H. Karchmar. *Analyt. Chem.*, 1957, **29**, 425–31.—In the potentiometric determination of mercaptans in gasoline using alcoholic silver nitrate, low results and poorly defined titration curves may be obtained with samples having a mercaptan–elemental sulphur ratio greater than 1 : 1 and when the sample remains in alkaline titration solvent some time before the titration. These poor results can be attributed to the formation of inorganic polysulphides. This interference can be reduced by titrating immediately under nitrogen and using a less alkaline solvent. J. S.

1156. Esso lamp method for sulphur. C. C. Hale, E. R. Quiram, J. E. McDaniel, and R. F. Stringer. *Analyt. Chem.*, 1957, **29**, 383–8.—Numerous variations in the lamp method for determination of sulphur in petroleum products are integrated to produce a method for rapid routine testing in a petroleum lab. 3 finishing methods, conductometric, nephelometric, and gravimetric, are available, depending on the nature of the sample. The reproducibility of the method was determined in a co-operative test of 12 samples by 4 labs. J. S.

1157. Infra-red absorption analysis in the petroleum industry. 2. Types of spectrophotometers available. R. Quarendon. *Petroleum, Lond.*, 1956, **19** (11), 405–8, 410.—A review of the design and arrangement of modern i.r. instruments is given. The functional parts described include energy sources, mirror systems, absorption cells, monochromators, optical materials, energy detectors, amplifiers, and output meters. Inherent advantages of the double beam spectrophotometer are being translated to the single beam model to reduce capital cost. Finally, the uses of nil-dispersion analysers are described. E. A. G. H.

1158. Spectrophotometric determination of chloride, bromide, and iodide. F. W. Chapman, Jr. and R. M. Sherwood. *Analyt. Chem.*, 1957, **29**, 172–6.—The determination of trace amounts of halogens in petroleum naphthas and cat is becoming increasingly important because of their harmful effect in cat processes. The organic halogens in petroleum naphthas are converted into water soluble inorganic halides by using disodium diphenyl reagent; cat can be prepared for analysis by standard methods of fusion with sodium carbonate. The aq soln is reacted with palladous sulphate and the absorbence of the reaction products is measured at prescribed wavelengths. Chloride, bromide, and iodide can be separated by preferential oxidn with manganese dioxide or lead dioxide. The time required for a complete analysis of a petroleum naphtha sample is *ca* 12 hr, and the standard deviation is in the order of 5% of the amount of halide present for both precision and accuracy. J. S.

1159. Vapour phase partition chromatography. I. J. Buzon and P. E. Moghadamo. *Rev. Inst. franç. Pétrole*, 1956, **11**, 1616–28.—Theory is discussed and results are given of trial runs with benzene ρn a column using N_2 as mobile and dinonylphthalate (DNP) as stationary phase. Qual separation trials made with columns using DNP (*cyclo*hexane–benzene), C_{20} paraffins (*cyclo*pentane-saturated C_6), glycerol (*cyclo*hexanol–*cyclo*hexanone; *n*-butanol–xylenes). Quant tests were made with benzene–*iso*-octane, toluene–*iso*-octane, and benzene–toluene. Finally, results are given of a quant analysis of a commercial xylene (separated by dist into 4 fractions) by v.p.c., i.r. spectrometry, and F.I.A. analysis; good agreement was obtained between the 3 methods. V. B.

1160. Applications of gas–liquid chromatography to analysis of liquid petroleum fractions. D. H. Desty and B. H. F. Whyman. *Analyt. Chem.*, 1957, **29**, 320–9.—Gas–liq chromatography has many potential applications in the separation and analysis of volatile fractions from petroleum, yielding information not obtainable by other techniques such as dist, i.r. or mass spectrometry. In this work the gas density balance has been used to determine the retention volumes of 81 hydrocarbons and 7 sulphur cpds boiling in the range 30°–150° C on both hexatricontane and benzyldiphenyl. Identification and estimation of minor impurities in reference fuel *iso*-octane are described. The impurities can be concentrated for further analysis. J. S.

1161. Quantitative determination of fluorinated hydrocarbons by gas chromatography. W. C. Percival. *Analyt. Chem.*, 1957, **29**, 20–4.—Mixtures of fluorinated hydrocarbons (freons) may be analysed rapidly, accurately, and conveniently by gas chromatography. Data have been obtained showing the accuracy and reproducibility for commercial mixtures of freon cpds. The method offers several advantages over the physical and instrumental methods used at present, and approx ½ hr is required to run and calculate the results of duplicate determinations. The variations in eluting gas flow rate and pressure, thermal conductivity cell current, ambient and column temp, length of adsorbent packing, and warm-up period require precise control to obtain reproducible results. J. S.

1162. The 1957 Physical Society Exhibition. Anon. *Petrol. Times*, 29.3.57, **61** (1556), 291.—A review is given of the scientific instruments and apparatus displayed, and includes those dealing with exploration, chromatography, dist, continuous analysis, electrophoretic separation, mass spectrometers, a spectrofluorimeter, radioactive techniques, computers, and servo test apparatus. G. A. C.

1163. The CLR oil test engine. W. G. Ainsley, A. E. Cleveland, and M. K. McLeod. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 579–93.—The paper outlines the development of a common oil test engine by the Co-ordinating Lubricant and Equipment Research Committee of the Co-ordinating Research Council Inc. A brief history leading to the development of the engine is given. Results are shown of a survey made among 40 laboratories to determine the design requirements of the engine, and the technique used by the survey team to arrive at these design requirements is discussed in some detail. The design and construction of the engine to

fulfil its desired design requirements is described, and schematic drawings and photographs of the prototype model are shown. Finally, it is indicated that this engine can be developed successfully into a satisfactory lab tool for lub oil evaluation. (Authors' abstract.)

CRUDE OIL

1164. Lowering of freezing point and viscosity of (paraffin base) crude oil as result of thermal treatment. J. Pohl. *Nafta (Krakow)*, 1956, **12**, 44–7.—Pumping of paraffin base crudes over long distance is very difficult, in particular in the winter. There are 4 methods of lowering the freezing point and visc of this crude, *i.e.* mechanical mixing, thermal treatment, dilution, or addition of an inhibitor. The second method involves heating and cooling, by which properties of the oil are changed, *e.g.* untreated crude with visc (kinematic) at 10° C = 122·36 cS will have after heating to 10° C visc 30·63 and after treatment at 60° C visc 25·05 cS. Also the freezing point will drop from 0° to −34° C immediately after treatment at 60° C and on standing settle at −10° C. Treatment at 20° C raises the freezing point. If the temp of the thermal treatment is *ca* 15°–20° C the visc also rises slightly. With the right treatment a minimum can be reached which depends on the nature of the oil. Some crudes may even show a greater visc at a higher temp if this is near the temp at which treatment gives max visc. All this is due to changes in the crystalline matrix. These are not permanent. Heating can be done in a heat exchanger, and cooling can take place in the pipeline. The treatment can be done only if the crude contains asphaltenes which are in colloidal solution. Several crudes gave no response to treatment. This happened where the amount of asphaltenes was relatively small. Sometimes it is possible to obtain an improvement in one of the properties and not in the other. M. S.

GAS

1165. Nitrogen in Polish natural gas. Z. Wilk. *Nafta (Krakow)*, 1956, **12**, 39–43.—The main constituent of natural gas is CH_4; other hydrocarbons, CO_2, N_2, and O_2 are present as well as cpds of sulphur and steam. Traces of He and CO have been found. The paper concerns itself with nitrogen only. There is native N_2 and N_2 derived from air. It affects compressibility of natural gas as well as its cal val. Deviations from ideal gas laws are in the process of investigation by the Petroleum Dept of the Mining and Foundry Academy. The elimination of N_2 in small concn can be done only by selective dist at low temp and a diagram of a plant according to Claude. Methane boils at −161·7° C and nitrogen at −195·8° C, so separation is quite easy. The value of Polish natural gas is *ca* £50 million. M. S.

1166. Application of an electronic computer to the calculation of the recovery of natural gasoline by refrigeration. S. M. Roberts. *J. Petrol. Tech.*, 1956, **8** (12), 24–9.—10 wet gases from 7 fields have been studied with the aid of an I.B.M. 650 computer to give the natural gas recovery by refrigeration. The initial contents of *iso*butane and heavier were 0·891–3·293 gal/M.c.f. The "flash" equation was used in a form suitable for minimum calculation time, and an 8-component system could be calculated in 30 sec for each pressure and temp combination. The pressures ranged 50–1000 p.s.i.a., and the temp −20° to +40° F. For all the gases the gasoline content of the discharge gas diminished approx linearly to *ca* 300 p.s.i.a. and then levelled off. Except for the leanest gas, 400 p.s.i.a. and 0° F would give a discharge gas with 0·45 gal/M.c.f. Under certain conditions 0·25 gal/M.c.f. could be attained, although with excessive recovery of propane and lighter components.

The extraction efficiency increased to *ca* 300 p.s.i.a. at a fairly uniform rate, and then levelled off. The recovery of *iso*butane and heavier attained 70% efficiency at 400 p.s.i.a. and 0° F for all but the leanest gas. Under certain conditions the efficiency was 90%. The richer the wet gas, the greater was the recovery efficiency at a given pressure and temp.

The computer flow sheet is given, and the curves of recovery efficiency and of gasoline content in the discharge gas at different pressures and temp are presented. The accuracy of the computations is examined and the principles briefly explained. G. D. H.

1167. Gasification of heavy oils. Application of petroleum residues to thermal utilization. (In French.) H. Guillon. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 541–51.—The gasification process described is an incomplete combustion producing a hot poor gas containing mainly carbon monoxide, hydrogen, and some light hydrocarbons. The oil is sent in a massive jet on to the generator sole-plate, the air is blown in, cold or heated, at medium pressure, through pipes, thus setting up progressive oxidn and a gas vortex; the gases separate at a temp corresponding to the thermochemical equilibrium achieved. The process is a continuous one. The automatic flow of gasification air and oil can be adjusted so as to leave a certain quantity of free carbon in the gas with a view to obtaining a flame with a very high emission potential. The process can be adopted for using extra-heavy petroleum residue containing mineral elements; in this case the generator is equipped with a movable sole to eliminate the residue. It has also been adopted for producing synthesis gas, using heavy oil and a mixture of oxygen and steam.
(Author's abstract.)

ENGINE FUELS

1168. Fuels and lubricants. Pt 1. Some considerations affecting their selection and use for road transport. G. G. Tresidder. *Auto. Engr*, 1957, **47** (3), 109.—It is necessary to control the following properties during manufacture, if a high quality motor spirit is to be obtained. They are volatility, O.N., gum content, and contamination. Operators' problems with spark ignition engines are briefly considered.

The properties of interest for fuels for road diesel vehicles are reviewed. They include cetane No., fl. pt., dist range, visc, cloud and pour points, gravity, carbon residue, and sulphur content. Diesel smoke is another subject considered.
D. K.

1169. The use of residual fuels in gas turbines. E. B. Evans, D. H. McLean, F. R. P. Sharp, and A. Winward. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 291–313.—It may be accepted that the further development of the gas turbine for marine and industrial purposes depends to a large extent on its ability to use residual-type fuels at higher temp. This paper discusses the effect of fuel oil ash constituents on high-temp deposition and corrosion and describes experimental work using both lab combustion rigs and a 750-kW industrial gas turbine. The effect of vanadium on corrosion is modified by the presence of sulphur and sodium in the fuel, and the proportion of sodium appears to affect not only the level of corrosion, but also the ease of removal of blade deposits. In the course of the work, numerous additives have been tested to ascertain their effect on the corrosion and deposit-forming tendencies of fuel oils in the temp range 1300°–1600° F (700°–870° C). Magnesium, zinc, phosphorus, and calcium cpds appeared the most effective, and in particular the use of magnesium was advantageous. Magnesium acetate gave, in general, better results than magnesium chloride or other salts. Aq injection of this additive into the fuel line before the high-pressure pump gave good distribution of the additive, and while eliminating corrosion, did not increase the deposits above

the original level of the fuel oil without additive. In addition, when using the additive, these deposits were more easily removed by water-washing. (Authors' abstract.)

1170. The development of fuels and lubricants in relation to diesel engine requirements. A. Wilson, N. Kendall, and L. E. Lowe. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 323–38.—Particularly within the last 30 years, considerable advances have been made in both the performance and application of the diesel engine. In some cases these have demanded corresponding changes in fuels and lubricants; in other cases improvements in fuels and lubricants have paved the way for further engine development. The paper reviews the trend of these interacting developments in the various fields of application up to the present stage of evolution and outlines the problems which currently exist. The situation which may be expected to develop, due, on the one hand, to further advances in engine design, on the other, to developments from the fuel and lubricants side, is examined against this background. Attention is drawn to the fact that changes in the fuel requirements of the various types of diesel engine, particularly when considered in conjunction with the needs of other prime movers, could materially affect the present balance of oil refinery operations; alternatively, considerations of optimum refinery balance could affect fuel specifications, and this should be taken into consideration in further diesel engine development. (Authors' abstract.)

1171. Modern diesel engines and the quality of fuels and lubricants. M. Zwicky. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 339–46.—General survey of modern designs and their characteristics. Steps taken by designers permitting the use of fuels of inferior quality and the limiting conditions for the use of these fuels. The requirements for lub oils and their standard analytical values call for a closer co-operation between designers of diesel engines and refiners of petroleum. (Author's abstract.)

1172. Adaptation of fuels to road performance. R. Vichnievsky, F. Kermarrec, R. Guyot, and J. Weissman. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 437–59.—Anti-knock requirements of French vehicles and road O.N. of different blends are presented in terms of primary reference fuels. Description of the test methods and procedure is followed by an evaluation of the anti-knock requirement of 200 vehicles. The study of the road O.N. of 18 blends made on 15 cars gives a fairly good correlation between road O.N. and lab ratings. (Author's abstract.)

1173. Influence of the chemical composition of fuels on detonation. A. Mora Agues and J. de la Ynfiesta. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 483–7.—A novel photographic system, connected to a piezoelectric quartz, is used to study the max pressure in an engine at detonating load, and it is shown that the knock waves of 2 fuels with a different chemical composition, but with the same O.N., do not reveal the same characteristics. Assuming that the effect of a pressure fluctuation is proportionate with the pressure variation amplitude and with the $\Delta P/\Delta T$ velocity at which it is produced, the formula $Q = \frac{(\Delta P)^2}{\Delta T}$ represents the mechanical effect of the detonation and shows that it is higher for a paraffin fuel than for an aromatic fuel with the same O.N. (Authors' abstract.)

GAS OIL AND FUEL OIL

1174. Experimental studies on a cyclone chamber for combustion and gasification of heavy liquid fuels. H. P. Havemann and K. Mahadevan. *J. Inst. Fuel*, 1957, **30** (192), 26.—A cyclone combustion chamber for a mass flow of ¼ lb/sec was designed and built. Experiments were made with different types of secondary-zone fuel injection systems for light diesel oil and preheated bunker oil. The injection of the secondary-zone fuel at the periphery of the volute in the direction of the gas flow was found to be advisable. Almost complete combustion of fuel particles is achieved, irrespective of the type of liq fuel, even when the air–fuel ratio is stoichiometric. Gasification is possible when the air–fuel ratio is gradually reduced to less than the stoichiometric ratio. The article is illustrated by many diagrams and charts. D. K.

1175. Is oil heat more efficient? R. E. Paterson and R. S. Wilcox. *Fuel Oil & Oil Heat*, 1957, **16** (3), 66.—2 independent investigations were made into the relative efficiencies of oil and gas used for automatic home heating in the U.S.A. One test showed both to be equal; the second showed oil to be more efficient, the average customer being able to save 5% of his fuel bill by using oil. D. K.

1176. Preventing sludge. How to test and measure the effectiveness of additives on the market to-day. W. H. Carls. *Fuel Oil & Oil Heat*, 1957, **16** (3), 70.—The nature of sludge in dist and residual oils is discussed. The use of additives for controlling sludge formation and accumulation and simple methods of determining their effectiveness are considered. Some electron micrographs show effect of additives on sludge. D. K.

1177. The use of heavy fuel oils in the gas industry. G. Malquori. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 499–511.—The paper provides a general picture and considerations on the economic and technical aspects of the gasification of residual fuels, for the production of gas interchangeable with both natural gas and the usual town gas. The author then deals with technical methods of gasification in separate production plants for the manufacture of high, medium, and low B.t.u. gas, and with their application to carburetting water gas and complete gasification gas. (Author's abstract.)

LUBRICANTS

1178. Research on the oxidation of lubricating oils. E. Bonauguri, G. Giusti, G. Jacini, and D. Rossetti. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 187–209.—A study is made of the behaviour of lub oils when oxidized. During the process of oxidn the effects of corrosion, development of acidity, sap. No., and change in visc are determined. After observing that the method employed (a variant of the Sunbury method) is latent with numerous sources of error and implies unrepeatable test conditions, the paper sets forth the development and control of a rational method. The experimental data thus acquired form the basis for establishing correlations, founded on a variable including the naphthene content of the oil and the mean mol. wt. (both taken relatively). These correlations enable the determinations necessary for a relative evaluation among the oils of one group to be limited to certain physical quantities: visc, mean mol. wt., higher critical temp of solubility with aniline, without resorting to the oxide test. (Authors' abstract.)

1179. Aramco processing of crude for lubricating oils and paraffin and wax derivatives. M. Chauvin. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 67–73.—First, the author discusses the general features of the Aramco processing of crude for obtaining lub oils and paraffin and wax derivatives. The French market is then studied with reference to the wishes of the customers in the light of a critical analysis of wax properties and measurement methods. Finally, information is given concerning the relation between the conditions of manufacturing in a refinery and the specifications of the products so obtained. (Author's abstract.)

1180. Recent trends in automotive lubricating oil research. G. H. Denison and F. W. Kavanagh. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 75–104.—The ever-increasing load placed upon the I.C. engine lubricant year after year has required the research laboratories of the petroleum industry to develop a wealth of knowledge of the chemistry, physics and engineering principles involved in lubricant performance. Skilful compounding of lub oils has been necessary to meet the advances made in I.C. engine design and operation and, indeed, has contributed to such advances. To a great extent, the progress in developing improved lubricants was made possible by rapid advances in the laboratories in learning and applying fundamental scientific knowledge. Lab engine test procedures were developed for predicting the field performance of lubricants. Quantitative scales for evaluating performance factors such as corrosion, wear, sludge, piston lacquering, ring groove deposits, etc., were also evolved. With engine test methods on a quantitative basis, the chemical reactions by which fuels and lubricants generate engine deposits and sludge were determined; from the knowledge of these chemical reactions, means of controlling them were developed. For example, the best ratios of detergents and alkaline additives were established. In developing such ratios, fundamental information was obtained on the chemical and physical phases of detergency. The chemistry of bearing corrosion was studied in petroleum laboratories, leading to the development of several means for its control. By the use of the radioactive ring technique, precise measurements of engine wear rates were made with experimental lubricants; this resulted in an improved understanding of engine wear and means for its control. Latest types of lub oils, which utilize polymeric thickening agents, give increased gasoline and oil mileage. The increased knowledge and improved techniques described resulted from a tremendous investment in petroleum research laboratories. The present paper reviews the growth of knowledge in this field and gives examples of how it was obtained. Only by use of scientific methods was such rapid progress possible.

(Authors' abstract.)

1181. Applications of some physical methods to lubrication research. F. G. Barwell, L. Grunberg, A. A. Milne, and K. H. R. Wright. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 115–36.—Early work in the study of lubrication and wear satisfactorily used simple methods of experimentation. In modern research, the necessity of studying processes in great detail requires the application of intricate physical methods. The electron microscope, with its high resolving power, has been applied in several instances. Worn surfaces show deep scratches which indicate that wear does not primarily proceed by the adhesion of intermetallic junctions. The metallurgical changes occurring in a scuffed area on a surface are revealed in detail. Again, some of the " carbon " particles present in used detergent lub oils are found to be only *ca* 500 Å in dia and cannot be detected by other methods. The structure of the soap fibres in greases suffers degradation in use. The topography of surfaces can affect the friction and wear behaviour. Stylus methods of measurement yield insufficient information, whilst optical methods such as interferometry, being more sensitive, sometimes introduce difficulties in interpretation. Physical measurements are made in the course of lubrication and wear experiments. Thus, in hydrodyamic lubrication, the thickness of the oil film separating the surfaces must be measured. An air gauging method has been used successfully for this purpose. The measurement of contact resistance reveals the instant of oil film breakdown or the nature of wear debris bridging the gap between surfaces. The use of radioactive tracers enables extremely small amounts of transferred metal and wear rates to be measured. Precautions have to be taken when handling radioactive isotopes, but the gain in sensitivity is so great as to make this worthwhile. Oxide films afford some protection to rubbing surfaces. Deformed oxide layers contain crystal imperfections from which electrons can be emitted by light and registered by special Geiger counters. Deformed oxide films also produce images on photographic plates. The intricacies of the methods of modern research require a close collaboration between physicists and engineers. In designing lubrication or wear experiments the limitations and difficulties of the physical methods employed must be considered.

(Authors' abstract.)

1182. Developments in dopes and additives. J. Artozoul, G. Avico, L. Boisselet, and A. Poussin. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 105–13.—Commercial akylaryl-sulphonates are obtained from mahogany acids or alkylaryl hydrocarbon mixtures which make it very difficult to ascertain the variations of a physical property (solubility in oils, dispersion coeff) in terms of mol structure. In the endeavour to interpret the results, individual alkyl–naphthenyl–aryl hydrocarbons were prepared by alkylating *cyclo*hexylbenzene, bi*cyclo*decylbenzene, *cyclo*hexyl naphthalene, tetrahydronaphthalene with primary aliphatic alcohols in the presence of boron fluoride. Still more complex molecules are obtained by fluoroboric condensation of organic hydroxystearates with phenols or alkylaryl hydrocarbons, which enable the synthesis of polyfunctional sulphonates. The second part of the paper gives some remarks on the preparation and stability of the OO, metal dialkyldithiophosphates. After referring to the commonly-used methods of synthesis and known properties, details are given of a method for salifying OO, dialkyldithiophosphoric acids with aq soln of mineral salts. Heat stability as well as that of organic aq soln of 4 dithiophosphates are specified. (Authors' abstract.)

1183. Lubrication in iron and steelworks. H. Jones and G. D. Jordan. *J. Iron Steel Inst.*, 1957, **185** (3), 389–408.—Pt I. This amply illustrated article discusses the lubrication engineer's duties. Characteristics—physical and chem—which influence the evaluation of lub oils and greases, and standard procedures adopted for their assessment, are described. It is emphasized that the overall performance of a lub is governed by the sum total of all its properties, but the significance of any sp characteristic will not be the same in all cases. It is advisable to limit the No. of lub to a minimum, retaining a sufficient variety to permit correct plant lubrication. It is desirable to control lub in an industrial unit by a classification method according to usage, and by a limited specification. An interesting colour code scheme evolved to improve control in distribution and application of lub as used in a major German concern is described and illustrated.

Pt II. The application of lub and the lub engineer's functions are outlined. General types of lubrication systems—centralized and non-centralized—are discussed and their basic features outlined. Sp applications—rolling mills, blast-furnace and melting shop equipment, are described in detail with diagrams. Special reference is made to improving lubrication of melting shop overhead cranes. R. T.

BITUMEN, ASPHALT, AND TAR

1184. Studies in shale oil. Pt VIII. Fluxing the blown bitumen. G. E. Mapstone and H. Karius. *J. Inst. Petrol.*, 1956, **42** (396), 361–9.—The paper reports experiments carried out to determine the effect of various cat on the blowing process. Ferric chloride is found to give the best result, halving the blowing time and improving the soft. pt.–penetration relationship. The effect of various fluxing oils on this relationship is also investigated. It is found that the presence of ferric chloride or hydrochloric acid has an appreciable effect on the response of the bitumen to fluxing oils,

particularly acid fatty oils. It is suggested that neutralization of free fatty acids and polymerization of the pyrroles present in the bitumen played a significant part in the improvement of soft pt and penetration. 10 refs. C. B.

1185. Adhesive qualities of bituminous binders to aggregates in road building and hydraulic work. A. Bénard and J. Lefol. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 11–28.—A widely-known method of improving the adhesive qualities of bituminous binding agents to aggregates for road building and hydraulic work consists of including surface-active additives in these binders. A more up-to-date method provides for introduction of the additives by direct application on the interface between the cementing substance and the aggregate. The first part of the paper reviews the technical and economical advantages of this new method. Lab tests, enabling an evaluation of the products efficacy in various applications, are described and discussed. In the second part, the respective influence of the various factors pertinent to the binding agents (visc, origin) and the aggregates (chemical composition, percentage of fine aggregate, porosity, specific surface) on the efficacy and economy of the method are examined. Conclusions are drawn pointing improvements in products and applicational techniques. (Authors' abstract.)

1186. Study of solvent extraction from bituminous coal. Pt III. (In Italian.) V. Berti, B. Casu, C. Marci, and C. Siniramed. *Riv. Combust.*, 1957, **11** (2), 91–104.—Continuing research on extraction by the solvent method from Sulcis (Sardinia) bituminous coal, investigations have been extended to the influence of extraction temp on the composition of the extracts. The following solvents were experimented with at the following temp: (1) tetrahydrofurane, 65°, 128°, 208°, 300° C; (2) morpholine, 128°, 208°, 300° C; (3) tetrahydronaphthalene, 208°, 350° C. The extracts obtained under the different conditions were analysed by the i.r. absorption method. Inspection of the spectra revealed, besides some details ascribable to the specific effect of the solvents, that temp affected the intensity of certain chemical functions. In particular, as far as aromatic cpds are concerned, it was found that at temp up to 208° C extraction is mostly of the less substituted cpds, while at higher temp there is indication of concomitant extraction of polysubstituted rings (polycondensates). (Author's summary.)

1187. Hydrogenation at medium pressure of crude and coal tar. (In Italian.) J. Varga. *Riv. Combust.*, 1957, **11** (2), 105–11.—Nagylengyel crude and 2 brown coal tars, diluted in their own fractions boiling up to 280° C, were hydrogenated in a reactor of 1·8 litres capacity with flowing cat at a rate of 1 kg/l cat space per hour and NN_3 synthesis gas at the rate of 2 Nm^3/kg charge feed. Medium pressure hydrogenation of Nagylengyel crude yielded almost 80% liq products boiling up to 325° C at atm pressure. Low temp brown coal tar was also processed with fairly good recovery to low boiling products that could be reformed on fixed cat beds to end products practically free from sulphur and of almost the desired fractional composition. (Author's summary.)

DERIVED CHEMICAL PRODUCTS

1188. Revamp nets extra capacity—cheaply. Anon. *Chem. Engng*, 1957, **64** (2), 146–8.—For an outlay of $148,000 Shell Chemical Corpn have obtained nearly $3 million worth of added dist capacity for its butadiene plant at Torrance, California, by substituting acetonitrile for acetone as the extractive dist solvent. This move boosted feed-preparation capacity by 58%. Acetonitrile has a greater effect than acetone in spreading apart the b.p.'s of C_4 hydrocarbons. D. H. A.

1189. Detergents from petroleum—the methods of synthesis. F. P. Taylor. *Petroleum, Lond.*, 1957, **20** (3), 103–5.—Initially the history of the growth of this industry is traced and account given of the circumstances which led to the production of synthetic detergents and their advantages over the common soaps. The manufacture of various types are outlined, namely secondary alkyl sulphates, alkane carboxylates, primary alkyl sulphates, alkyl–aryl sulphonates, keryl benzene sulphonates, and alkyl sulphonates. The author also distinguishes between the cationic and non-ionic types. E. A. G. H.

CORROSION

1190. Refiners move in on corrosion. M. S. Northup. *Oil Gas J.*, 4.3.57, **55** (9), 108.—The Subcommittee on Corrosion, Division of Refining, API has shown that corrosion is costing the petroleum industry *ca* $300,000,000 p.a. Objectives for a model refinery organization to combat corrosion are stated. G. A. C.

1191. Hydrogen attack at a catalytic cracking unit—steps to avoid low temperature corrosion. B. W. Neumaier and C. M. Schillmoller. *Petroleum, Lond.*, 1957, **20** (1), 14–18.—The two major protecting steps incorporated in the design of a particular fluid-unit gas plant were based on changes in environment created by: (1) early removal of hydrogen sulphide, and (2) extensive water-washing, starting at the fractionator overhead system. The exploration of corrosion constituted analysis of all process streams and monitoring of hydrogen attack by installing probes. The utility of organic inhibitors is also mentioned, while, in concluding, the authors state that corrosion prevention is most effective when applied in the design stage of a unit. E. A. G. H.

1192. Cathodic protection progress report. E. P. Doremus. *Pipe Line News*, 1957, **29** (1), 48.F–50.—The cathodic protection system used on the America Louisiana pipeline is described. Since it is expensive to locate and protect any local areas of corrosion, it is more economic to protect the whole pipeline cathodically, even if it is well coated. D. B. S.

1193. Here's why underground pipe corrodes. Anon. *Oil Gas J.*, 11.3.57, **55** (10), 133.—Figures clearly depict galvanic cells set up in pipes, and common methods for preventing stray-current corrosion and cathodic-protection systems. G. A. C.

1194. New coating for marine lines. W. R. Quarles. *Pipe Line News*, 1956, **28** (12), 21–3.—Coatings for submarine pipelines must combine sufficient weight to anchor the line with resistance to attack. The use of a rubberized asphalt mastic, internally and externally reinforced with glass fibre and filled with a barites aggregate, is described. This material was applied at 260° F but cooled to 80° F before being lowered, it has the advantage that it is more easily applied than concrete–enamel coatings and also that it may be laid in deeper waters because of its pliability. D. B. S.

1195. Sprayed metals plus plastics. W. B. Meyer. *Pipe Line News*, 1956, **28** (12), 44–8.—Corrosion protection by spraying metals on suitably prepared surfaces is discussed. Bare metal coats may be used to provide protection against electro-

chemical attack if they are anodic to the surface being protected. Thinner coats may be used if the surface is overcoated with vinyls, chlorinated rubbers, and silicone soln. Such coatings afford good protection against corrosive and humid atmospheres. Recent developments have shown sprayed coatings of both anodic and cathodic metals impregnated with heat-cured and cat-cured phenol and phenol–epon formulations, epoxy and furane resins, liq neoprene, thiacol, etc., to be promising under severe conditions.

D. B. S.

ENGINES AND AUTOMOTIVE EQUIPMENT

1196. A unified concept of combustion in I.C. engines. D. Downs, J. C. Street, and R. W. Wheeler. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 461–81.—Each particular type of I.C. engine has its own problems of combustion. In the spark-ignition engine, in addition to the ignition and propagation of the flame across the combustion chamber, these are detonation (or " knock "), pre-ignition, and running-on. In the diesel engine the ignition quality of the fuel is important from the point of view of cold starting and noise, while in the gas turbine, the problems are mainly ignition, flame stability, and combustion efficiency. Although these various phenomena are distinct and are often differently affected by changing temp, pressure, and time conditions, they are all nevertheless related to the same fundamental oxidn mechanisms of the fuel. The paper presents a summary of recent experimental evidence linking these engine phenomena with fundamental chemical information obtained under lab conditions. It is shown that all these phenomena are special cases of " high " or " low " temp oxidn on the Townend ignition temp–pressure curve. This " unified " concept of engine combustion is particularly valuable when considering the spark-ignition engine, where the effects of combustion chamber deposits on pre-ignition and knock are so closely interconnected, and where fuel temp sensitivity seems to involve both " high " and " low " temp ignition. (Authors' abstract.)

1197. Combustion chamber deposits in automobile engines. W. G. Lovell, H. J. Gibson, and B. A. Jones. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 553–77.—Combustion chamber deposits that accumulate in automobile engines have at least 2 deleterious effects. First, they gradually increase the gasoline anti-knock requirement to suppress ordinary knock. Secondly, they contribute to the occurrence of abnormal combustion phenomena such as surface ignition or pre-ignition, which in turn results in knocking noise and inefficient and erratic engine operation. These deleterious effects are a limiting factor in the full utilization of higher O.N. fuels. The 2 deleterious effects can be significantly reduced by careful selection of fuels and lub oils. A more recently introduced method of reducing the undesirable surface ignition effects is by modifying them with phosphorus-type fuel additives. In addition to reducing the tendency toward pre-ignition, phosphorus additives also inhibit spark plug fouling by modifying the deposits on spark plug insulators. In general, the petroleum and automotive industries are devoting extensive research effort to reach more effective solutions to the problems resulting from deposits. Because of such effort, it is likely to be only a matter of time before improved commercial solutions will be forthcoming, after which further increases in automobile engine efficiency will be achieved through the use of engine C.R. even higher than those current to-day.

(Authors' abstract.)

1198. The chemistry of combustion chamber deposits. J. J. Mikita and B. M. Sturgis. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 357–80.—A study of the chemical characteristics and reactions of combustion chamber deposits has yielded information on the way in which they are formed, the way in which they reach and maintain equilibrium, and the methods by which they cause pre-ignition and increase engine octane requirement. Unburned portions of fuels and oils accumulate in combustion chambers to form a carbonaceous layer, which then traps lead oxide resulting from combustion of the TEL. The lead oxide which has deposited on the surface can react with hot acidic gases in the fuel combustion products to form a complex mixture of lead epds. These build up to equilibrium and then are gradually removed by volatility mechanisms and flaking and flecking processes. These deposits cause an increase in engine octane requirement because of their volume effect, their thermal insulation properties, their heat capacity, and the fact that they can cause surface ignition of the incoming charge. This surface ignition is due to glowing particles of carbonaceous material catalysed by the presence of lead epds. Deposit harm has been reduced by the proper selection of fuels and lub oils and by the addition of chemical materials which will change the composition of deposits. The incidence of pre-ignition depends not only on deposit composition but on fuel structure. The tendency for fuels to be ignited by deposits has little relationship to fuel O.N. and must be considered in the development of improved fuels.

(Authors' abstract.)

1199. Experience in service with gas turbines using heavy fuel oil and the application of gas turbines in the petroleum industry. H. Pfenninger. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 263–90.—The article describes the phenomena of corrosion, erosion, and ash deposition in gas-turbine blades by means of examples when heavy fuel oil is used. The operating experiences with the gas-turbine power station at Beznau, Switzerland (40,000 kW), the gas-turbine plant at Pertigalete, Venezuela (2, each of 1650 kW), and the gas-turbine locomotive of the Swiss Federal Railways (1600 kW) are discussed and the chemical analysis of the fuels used given. The gas inlet temp for the turbines in the Beznau power station is 1200° F, while in the other 2 plants the temp is 1110° F. With these gas temp, no corrosion of the blades has been found. Ash deposits do not exceed acceptable limits for industrial operation. The method of removing the fuel ash from the blades is described. Of the gas-turbine plants installed by the petroleum companies, 2 are described in some detail. One of these is the Tembi power station belonging to the British Petroleum Co in Persia. In this power station 2 gas turbines, each of 4000 kW output, are installed with an air inlet temp of 95° F. The other one belongs to the American Oil Co in Saudi Arabia. In this power station 6 units are installed. 3 of these have been put into industrial operation up to the present : each has a capacity of 5000 kW at an air inlet temp of 120° F. These power stations are so designed that they do not require any water supply at all. With the present state of development, gas turbines have the same reliability in service as steam turbine installations. Heavy fuel oil can be used without difficulty for gas inlet temp up to 1200° F. The maintenance costs of these machines amount to approx 0·025 U.S. cents/kW hr. In comparison with other prime movers it is apparent that the gas turbine can well compete for unit outputs up to 25,000 kW.

(Author's abstract.)

SAFETY PRECAUTIONS

1200. Extinguishing oil fires—the use of the box bolt-driving gun. S. Harrison. *Petroleum, Lond.*, 1957, **20** (2), 64.—A condensed version of a paper in *J. Roy. Soc. Arts*, 1956, **104**, Pt 4990, 979. E. A. G. H.

MISCELLANEOUS

1201. The Indian petroleum industry—the influence of the second Five Year Plan. T. H. H. Skeet. *Petroleum, Lond.*, 1956, **19** (12), 425–30, 444.—During the first Five Year Plan, 7% of India's oil requirements were produced at home. In the light of the high expenditure in oil imports and the new policy for land reform, amongst other factors, the author reviews the effect of the second Five Year Plan on ownership, exploration, production, refining, transportation, and marketing. Mention is made of Soviet experts' general mineral survey carried out over the whole country. E. A. G. H.

1202. Construction of contour planes in strongly inclined seismic horizons. (In German.) J. F. de Caleya and R. Kohler. *Erdöl u. Kohle*, 1956, **9**, 280–3.—A geometric method is given by which the sounding pt and ft pt position of the reflecting ray are determinable. The distance between this sounding pt and its projection on the earth's surface corresponds to the true depth of the reflection horizon under the projection pt. The illustration contains 3 profiles, therefore 2 *D*-pt joined by the interpolation line. The true depth is obtained from the following equations: $\cos\alpha = \frac{h}{L}$; $\sin\delta = \frac{T}{L}$, and therefrom $h = T \cdot \frac{\cos\alpha}{\sin\delta}$, where α = true dip of reflection horizon, h = true depth under *D*-pt, I = depth read on profile, L = intersection pt of profile on reflection horizon, δ = angle between sounding pt and profile line. Examples of applications are illustrated and discussed. R. T.

1203. United Kingdom petroleum legislation in 1956. V. Biske. *Petrol. Times*, 29.3.57, **61** (1556), 283.—This review of legislation includes that relating to oil on navigable waters, taxation of petroleum, customs regulations, control of petroleum, and safety precautions. Some judicial decisions are also discussed. G. A. C.

1204. Radioactivity and the oil industry. Anon. *Petrol. Times*, 29.3.57, **61** (1556), 279.—Extracts are given from a recent survey of industrial applications of radioactivity by Tracerlab Inc in the U.S.A., and include exploration and production, transportation, and refinery applications, such as measurement of flow rates in condensers, cat crackers, and mixer efficiencies. G. A. C.

1205. The tasks of the petroleum industry in the 5-year plan. Z. Zborowski. *Nafta (Krakow)*, 1956, **12**, 29–33.—The objective of the 5-year plan is to reduce the lag between the petroleum industry and the other industries of Poland. By providing, as intended, more fuels and lubricants for Polish agriculture and transport, the petroleum industry will make up for pre-war neglect. In the foreground is the need to find new resources, of which there has been an indication in the N. 75% of the drilling projected is to be done in those regions. A much greater expansion is planned for the seismic and other preliminary work. The seismic apparatus is to be supplied by the U.S.S.R. The exploratory drilling is to go up by 55% and seismic investigations by 600%. Drilling methods should be modernized and scientific work on portable equipment, muds, and methods will be expected to contribute to it. In production it is expected to maintain rates such that all oil can be got out, and that is why production of natural gas cannot be expected to rise. In refining, old refineries are to be modernized, in particular by introducing selective refining in a much greater number of works. Greater power economy is a very important problem also. The sixth refinery, which will actually be ready in 1961, figures prominently in the 1956–60 plan. Well in front of all the building plans is the projected increase of consumption of petroleum products, which will double itself during these 5 years and require an extension of all handling and storage facilities. A great extension is also required in the equipment factories and refinery building enterprises. As a result, it is expected that cost/ton and cost/m drilled will fall and value of product obtained from a ton of crude should rise. M. S.

1206. Henry Darcy—engineer and benefactor of mankind. G. Fancher. *J. Petrol. Tech.*, 1956, **8** (10), 12–14.—Darcy was born in 1803 at Dijon. In 1826 he graduated as an engineer. After a short period of employment in the Department of Jura he returned to Dijon, where he studied and analysed the not very dependable water supply, a source of trouble for 400 years. Eventually he made use of a good spring 7 miles above Dijon, and designed 2 reservoirs and a distribution system involving 3·5 miles of aqueducts and stonework, over 7 miles of cast-iron pipe, 120 water posts, a fountain, and other features. In 1840 water began to reach the Dijon reservoir at the rate of 2000 gal/min. He would accept no fee for this work, and received various honours. In 1840 he became Chief Engineer of the Department of Côte d'Or. Later he took part in the planning of the Paris–Lyon railway. He became Engineer and Chief Director of the Service of Water and Pavements in Paris, a difficult post complicated by the political situation. At Chaillot he carried out experimental work on hydraulics. He gave advice in Brussels and visited London to study macadam paving. From 1842 until his retirement in 1855 his health deteriorated. He then pressed on with research and writing until his death in 1858. He studied flow in pipes as well as through porous media, and designed and constructed a Pitot tube. His colleagues, Dupuit and Bazin, continued his work. G. D. H.

1207. Survey of refineries in the United States. Anon. *Oil Gas J.*, 25.3.57, **55** (12), 121.—Location and capacities are given of operating refineries in the U.S.A. of as 1 Jan 1957. Total capacity of all types of refinery amount to nearly 9,600,000 b.s.d. G. A. C.

1208. Better repair welds on high test pipe. A. M. Hill and F. W. Zilm. *Pipe Line Ind.*, 1956, **5** (5), 62–78.—Underbead cracks occur frequently in welding high-test line pipe by conventional procedures for producing high-quality welds. A series of welds on test chambers 24-in O.D.—artificially cooled to simulate pipeline conditions—were subjected to destructive and non-destructive tests. High yield strength pipe is shown to be very sensitive to the quenching effect of contained liq. Cracks occur, and the metal hardens in the heat-affected zone. A patch or branch connexion saddle welded on to the high-test pipe reduces its ultimate strength. Stresses concentrate in the fusion line of the weld parallel to the pipe axis. Welds consistently free from underbead cracks are obtained with low-hydrogen electrodes, both conventional and iron powder type. Advantages of these types are listed. Satisfactory testing procedures and filler materials are evolved for welds on pipes and fittings. Penetrant dye is used for exposing bead cracks. R. T.

1209. The use of oil refinery gases for public gas supply. C. F. Rüter. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 489–98.—In view of the development of the use of oil refinery gases for public gas supply, as, for instance, in the W. part of the Netherlands, a review is made of how co-operation between oil refineries and public gas suppliers can be established in a way that is attractive both from a technical and an economical point of view. The paper deals with: (1) the possibilities of applying refinery gases for public gas supply purposes; (2) the requirements which the refinery gas

should meet; (3) the various methods on which the application can be based, namely, mixing with other gases or conversion into a gas with a lower cal. val.

(Author's abstract.)

1210. Utilization of petroleum products and the evolution of production techniques of town gas in France. R. C. Delsol. *Proc. Fourth World Petrol. Congr.*, 1955, **6**, 513–39.—During recent years the French gas industry has been consuming increasing quantities of different petroleum products, with the aim of producing increasingly large quantities of peak load gas, and, at the same time, basic gas; improving production cost in certain cases; promoting the use of those fuels which have become progressively more and more available through the development of the French refining industry. The new techniques adopted or tested by the French gas industry concern production of the conventional town gas or peak load gas by cat conversion of gaseous hydrocarbons such as contained in natural gas, LPG, and gaseous by-products of refining processes (Hercules–Powder, Carbofax, Stark, O.N.I.A.–G.E.G.I., etc., processes); production of gas with a more or less elevated cal. val. (4000–10,000 kcal/m³) by thermal or cat cracking of liq petroleum products such as gas oil, paraffin dist, and mainly heavy fuel oil (O.N.I.A.–G.E.G.I., Hall processes); and direct use of gaseous hydrocarbons for distribution in the natural state and for cold carburetting other gases. The above-mentioned technical methods are examined in the paper. (Author's abstract.)

BOOK REVIEWS

Petroleum and its Products. J. H. van der Have and C. G. Verver. London: Pitman, 1957. Pp. viii + 421. 50*s*.

This is a good book. It was originally written for the students of Dutch technical schools. Now it has been rewritten, brought up to date, and admirably translated into English. It is well printed in clear type on good paper, and when laid on a table and opened it remains open at the right page.

There are chapters on the drilling and production aspects, on general refining principles, on refining processes, and on the characteristics of the products obtained. It is a mine of accurate information, and the reviewer has not so far discovered a printer's error.

The final two chapters on insecticides and petroleum chemicals bring the reader right up to date in a general sort of way without plunging him into a mass of intricate detail.

There are some old friends to be found in the book, such as the Gyro and the T.V.P. The reviewer remembers visiting the T.V.P. pilot plant at Texas City in—was it 1928? However, these old processes illustrate a technique and justify the single paragraph allotted to them.

That the authors have a good sense of relative importance is exemplified by the fact that the 60-page chapter on physical methods of separation, which deals with 8 different techniques, has some 30 pages devoted to a thorough and understandable exposition of the science of distillation, which, after all, is still the most important weapon in the refiner's armoury.

A glance through the index discloses a fine selection of words and phrases—Peptizing Additives, Biocides, C.V.P., Green Acids, Neutron-curve Logging, Rheology, Sapropel. However, on looking them up one is surprised at the simplicity with which they are explained in the text. This is a book which is easy both to read and to understand.

There will be some who read this review who have reached that stage in their career when their task is to guide the young and energetic along a sound path rather than to master the ever-increasing complications of technological advances. They may sometimes feel after a conference with their juniors that they are less familiar with Mersolization, Thixotropy, and Systemic Insecticides than they would wish. Let them keep a copy of "Petroleum and its Products" in their desks and they have but to open the drawer to find out what the boys have been talking about all afternoon.

C. V. H.

Tiefbohrgeräte. Gottfried Prikel. Vienna: Springer Verlag, 1957. Pp. 305.

This book is intended to fill a gap in German technical literature, and to provide a handbook for young engineers. It does not purport to cover all types and all details of deep drilling equipment, but is meant to offer a comprehensive review of the types, constructions, and applications of drilling equipment and auxiliaries which have, for the greater part, been developed and in use since world war II.

The latest drilling techniques are not dealt with in this book. They will form the subject of a second volume, now in preparation.

After an introduction, giving a classification of hardness of formations to be penetrated by the drill and a short historical review of the development of drilling through the ages (one misses a mention of Colonel Drake's well), the following chapters briefly cover hand drilling equipment for shallow geological core holes, and rotary drilling equipment for deeper geological core holes. In dealing with the latter, diamond core heads and core heads with hard metal inserts have received more extensive treatment.

Some further chapters are devoted to percussion drilling, either with cable tools (Pennsylvanian system) or with rods (Canadian system), and to a system of fast percussion drilling with hollow drill pipes and mud circulation, a system developed by German factories, which was used extensively in Germany and Eastern Europe some 30 years ago.

A chapter on counterflush drilling for deep core holes as well as for large-diameter shallow holes more or less marks the changeover from what might be considered to be mostly historical drilling methods and equipment to the modern rotary drilling system.

By far the greater part of this book is devoted to modern rotary drilling rigs with their component parts, which are described in successive subdivisions of Chapter XI, namely, derricks, drawworks, hoisting accessories, rotary equipment, engines, slush pumps, subsurface equipment, and some accessories.

Some old designs are illustrated, as well as equipment at present in use. A number of tables give the dimensions of derricks, wire ropes, and drill pipes, according to API standard specifications, while different types of slush pumps are listed, together with their dimensions and characteristics.

Some layout drawings of rotary rigs are discussed, while graphs present power characteristics of diesel engines, torque converters, and the pressure and capacity curves of double-acting slush pumps.

At the conclusion of this chapter some examples of calculations of power requirements for mud circulation, rotation, and hoisting are explained, as well as calculations of line pull *v.* hook speed.

The last chapter gives some information on portable drilling rigs for seismic shot holes.

The book concludes with general remarks on the progress made in developing rotary drilling equipment to meet the

ever-increasing demand for oil, which necessitates the drilling of deeper wells in the most economical way and the speeding-up of drilling operations. In this connexion some recent developments are mentioned, for instance, jet bits, slim hole drilling, and turbine drilling.

Although it cannot be expected that all subjects can be treated extensively in a book of this limited size, it is considered to give young engineers a good indication of the multitude of equipment involved in a modern drilling outfit.

However, no mention is made of rotary fishing tools, formation testers, deviation survey tools, casing and tubing string design, or well completion equipment. Nor is any description given of one of the vital components of a rotary drilling rig, namely, the safety equipment installed at the borehole to prevent blowouts during drilling.

It may be assumed that the author plans to incorporate these items in his second volume, as is indicated in the case of other subjects which are treated only briefly in the first volume. Nevertheless, one feels that it would have been preferable to insert some description and/or drawings of the above equipment in this first volume.

The book is well printed and indexed, and the text is provided with many tables, diagrams, and clear illustrations, not only of American equipment, but also, as might be expected, of equipment manufactured in Europe. A bibliography has been added. C. D. D.

Vapour Phase Chromatography. Ed. D. H. Desty. London: Butterworths Scientific Publications, 1957. Pp. xvi + 435. 70*s*.

In view of the already numerous applications of gas chromatography, both in industry and research, and the increasing interest in its potentialities, the publication of this book is very opportune. It is a full record of the proceedings at the 1956 London Symposium on Vapour Phase Chromatography, containing the 36 papers presented, the subsequent discussions, and the recommendations made on the standardization of nomenclature and the presentation of published data.

Some theoretical aspects of gas chromatography are considered, also the factors influencing separation, *e.g.* column temperature, nature of the stationary phase, etc. Five articles are chiefly concerned with the characteristics of katharometers and 4 more with other types of detector. It is particularly interesting to note the full description of the hydrogen flame detector which will be of great help to those who wish to construct their own simple yet sensitive apparatus. A number of analytical applications, both of gas–liquid and gas–solid chromatography, are given. The uses of these techniques in the petroleum industry are exemplified by the descriptions of solvent analyses, examination of vapour samples from an internal combustion engine, and the Janak method for the analysis of refinery gas streams.

The discussions provide much additional information but also serve to illustrate the confusion existing on different aspects; for example, the relative merits of spiral and straight columns, or the effect of variations in operating pressure on column efficiency, etc. The suggestions for nomenclature and standardization of data will help to lessen this confusion, although it is unfortunate that the title should perpetuate one of the terms no longer recommended for use.

This book is the most comprehensive survey of gas chromatography yet published. The editors must be congratulated on its appearance so short a time after the Symposium was held. Those already working with this technique will find in it invaluable information and references. The inclusion of an index would, however, have been of benefit, particularly to the newcomer. Nevertheless, the book can be strongly recommended to everyone who is interested in knowing more of this important and fascinating subject. C. F. B.

ADDITIONS TO THE LIBRARY

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1211. Areas of interest in marine oil prospecting. T. R. Goedicke. *World Oil*, 1956, **143** (6), 116.—World offshore areas which offer good prospects for oil discovery and development are briefly reviewed. These areas are most promising where sedimentation has been continuous throughout the Tertiary and where the present seas are relicts of major Mesozoic and Tertiary geosynclines. They include the Caribbean, the Mediterranean and Adriatic, and the Persian Gulf areas. In the Caribbean and the Persian Gulf there has been successful co-ordination between oceanography, involving sea-floor coring, and offshore geophysical work. C. A. F.

Q

1212. Deep Edwards reservoir in " shallow country." R. M. Knebel. *Oil Gas J.*, 7.1.57, **55** (1), 166.—A fault trap accumulation has been found in the Fashing area in Atascosa County, Texas, where the Edwards limestone is productive on the upthrown side of a normal fault. The geology of the field is briefly described. The top of the Edwards is at *ca* 10,000 ft and the throw of the fault is *ca* 800 ft, and the discovery well on test flowed 5058 M.c.f.d. gas and light dist. The limestone has secondary irregular porosity.

It is believed that there may be similar fields in the area. C. A. F.

1213. Stratigraphic relations in Chiricahua and Dos Cabezas Mountains, Arizona. F. F. Sabins, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (3), 466–510.—The 1953 discovery of oil in the Railroad Valley area of Nevada has revived interest in the Basin-and-Range Province as a possible petroleum province. SE. Arizona and adjacent parts of New Mexico are typical of the Basin-and-Range Province and have relatively thick sections of Palæozoic and Mesozoic strata. The Chiricahua and Dos Cabezas mountains are centrally located in this area and contain excellent exposures of all the Palæozoic systems, except the Silurian. Lower Cretaceous rocks are also well exposed. It is hoped that this report may be of some aid in evaluating the petroleum potentialities of this little-known area. E. N. T.

1214. Kansas—happy hunting for independents. N. S. Morrisey. *Oil Gas J.*, 18.3.57, **55** (11), 117.—Oil possibilities of Kansas and some recent discoveries in the state are briefly outlined. Most successful geophysical work has been carried out on the Central Kansas Uplift, but as this has been largely developed, exploration is being stepped out into the deeper parts of the basin. Isotime seismic mapping has proved a reliable exploratory technique, and the main search is for stratigraphic traps, with Pennsylvanian sands on the flanks of the uplift being closely studied. Electric log cross-sections of some recently discovered fields are included. C. A. F.

1215. Proposed nomenclature of part of Upper Triassic strata in Southeastern Utah. J. H. Stewart. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (3), 441–65.—Recent geologic study in SE. Utah has yielded new information on the stratigraphy of the Shinarump conglomerate and Chinle formation, both of Late Triassic age, and has led to a re-appraisal of the nomenclature of these strata. This report proposes changes in the nomenclature of the Shinarump conglomerate and the Chinle formation and summarizes the new knowledge of these formations. E. N. T.

1216. Significant Lower Palæozoic finds in Anadarko basin. J. A. Kornfeld. *World Oil*, 1956, **143** (6), 107.—There have been important recent discoveries in the Ordovician and Pennsylvanian in the Anadarko basin of W. Oklahoma. 4 of these are discussed, the Knox–Simpson field in Grady and Stephens Counties (Simpson pay in a faulted anticline), the Apache NW. field, Caddo County (Bromide pays in an overthrust structure), W. Cement field, Caddo County (5 Pennsylvanian oil and gas pays in a faulted anticline), and Oakdale field, Woods County, where the Simpson has been found productive and where several gas-dist reservoirs have been found in the Pennsylvanian and in the Hunton limestone.

A map shows the subsurface structure of the Anadarko basin in the Panhandle area. C. A. F.

1217. Jurassic stratigraphy of Williston basin area. D. R. Francis. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (3), 367–98.—Jurassic rocks are widely distributed in the W. interior region of N. America, extending from Arizona and New Mexico in the S. to Alberta, Saskatchewan, and Manitoba in the N. From the Rocky Mountain front of the U.S.A. and Canada they extend E. to Kansas, Nebraska, N. Dakota, S. Dakota, and Manitoba, underlying the entire states of Wyoming and Colorado.

This paper is a study of the Jurassic rocks that underlie the provinces of Saskatchewan and Manitoba in Canada, the state of N. Dakota in the U.S.A., and that part of the state of Montana that lies due S. of Saskatchewan. This area is here referred to as the Williston basin area, although it extends beyond the geological boundaries of the basin. Within the area of study, exposures are found only in the state of Montana.

Data are used from 281 control points in an attempt to relate the Jurassic sediments found in the subsurface of the Williston basin area to type sections in W. Montana, Wyoming, and S. Dakota. E. N. T.

1218. Marine Jurassic of Northern Rocky Mountains and Williston basin. J. A. Peterson. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (3), 399–440.—Regional studies indicate that the pattern of sedimentation within the Jurassic seas of the N. Rocky Mountains was influenced by several associated palæotectonic elements. The major negative-trending elements were the Alberta and Twin Creek troughs and the Williston basin. The major positive-trending elements were the Belt island and the Sheridan arch. Regionally, the marine Jurassic can be separated into lithogenetic units whose characteristics appear to be directly related to the presence of sedimentary environments, the nature of which was governed by the position and relative activity of the various palæotectonic elements. E. N. T.

1219. Three strikes give Rockies a lift. F. J. Gardner. *Oil Gas J.*, 7.1.57, **55** (1), 165.—3 recent discoveries in the Rocky Mountain area of the U.S.A. are briefly described. 1 Tange, Sheridan County, Montana, was completed in the Silurian at *ca* 9000 ft, producing 2742 b.d. of 39·9° oil, and future prospects of the Silurian in N. Montana are good. 1 Goftena, Musselshell County, Montana, found 40° oil in Pennsylvanian Amsden at *ca* 6300 ft. Pay is fractured dolomite. 1 Smith, Bottineau County, N. Dakota, found Trias Spearfish oil on drill-stem test at *ca* 3400 ft. C. A. F.

1220. Santa Fe springs adds 110-acre pool. C. L. Doyle. *Oil Gas J.*, 24.12.56, **54** (86), 115.—The development of the Santa Fe Springs field, California, is briefly outlined, and the geology of a new pool discovery in the field is discussed. This pool, discovered in 1956, has now been drilled up with 29 wells covering a proved area of *ca* 110 acres and is known as the Santa Fe zone. It lies below the Clark-Hathaway in the Upper Miocene and is the deepest producing zone in the field at a depth of *ca* 9000 ft, the crest at this level being displaced *ca* 1500 ft E. of the Meyer crest due to Miocene thinning. The zone is divided into the upper, 450–500 ft thick, containing 150–200 ft of sand, and the lower, *ca* 400 ft thick, containing 100–150 ft of sand, and spot cores indicate that permeability and porosity decrease with depth.

Peak production of 6000 b.d. from the pool was reached in July 1956 with 17 producing wells. C. A. F.

1221. Peru test finds oil. Anon. *Oil Gas J.*, 18.3.57, **55** (11), 106.—A well on the Ucayali river, *ca* 93 miles N. of Pucallpa in E. Peru in the Amazon basin is reported to have found oil.

The discovery is *ca* 140 miles N. of Aguas Calientes, discovered in 1938, which is producing *ca* 2000 b.d. C. A. F.

1222. Cretaceous Flysch and Molasse in Departamento Ultima Esperanza, Magallanes Province, Chile. G. O. Cecioni. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (3), 538–64.—The Departamento Ultima Esperanza is the northernmost subpolitical division of the Chilean Magallanes Province, and is located W. of the extra-Andean region of Argentine Patagonial.

In this study, the presence of sediments with facies of the orogenic Flysch, " Macigno," and Molasse in the Cretaceous

of this Departamento is demonstrated. These sediments and their palæontological contents indicate the sub-Hercynian phase, where the pre-kata-epi orogenic stages can be differentiated. The palæo-Andes were erected during the kata-orogenic stage; upon them mountain glaciers were probably developed, and a theory is advanced that they unloaded a great amount of gravel in the trough where the orogenic Flysch was being deposited. E. N. T.

1223. Ghawar gets 12-mile stepout. Anon. *Oil Gas J.*, 1.4.57, **55** (13), 95.—The Ghawar field in Saudi Arabia has been extended a further 12 miles by Ain Dar 56, which was completed at *ca* 7100 ft in the Arab D zone. Ghawar, which extends for over 140 miles, was formerly thought to be a series of 4 adjacent fields. *Ca* 75 wells are producing *ca* 670,000 b.d. C. A. F.

1224. Algeria perks up. Anon. *Oil Gas J.*, 11.3.57, **55** (10), 116.—A new deep pay has been found in the Edjele field in the Sahara desert. Since discovery 10 shallow wells with a potential of 20–50 brl/hr have been drilled in the field.

At Tiguentorine, 43 miles W. of Edjele, a well has tested *ca* 30 brl/hr of high quality oil from a zone between 1500 and 2000 ft. C. A. F.

1225. Cambrian seen as Australia's bright hope. W. D. Mott. *Oil Gas J.*, 31.12.56, **54** (87), 173.—10 deep tests were completed in Australia in 1955, and in Papua 1 Keru found gas at 998 ft in Miocene limestone. Showings of oil and gas in the Cambrian in the Pirie-Torrens basin in S. Australia and elsewhere have focused interest in this formation, which, in the areas of interest, consists of unmetamorphosed limestone, dolomite, sandstone, and shale, as containing possible source and reservoir beds.

Recent oil operations in various parts of Australia are briefly noted. C. A. F.

1226. Lower Carboniferous reefs of Northern England. D. Parkinson. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (3), 511–37.—In this paper a general account is given of a peculiar facies in the Lower Carboniferous of N. England, the origin of which has given rise to much controversy. This facies is most prominently displayed in the limestone hills named " reef knolls " by Tiddeman. The evidence is reviewed and the conclusion reached that these features are in fact reef-like in origin and are not merely unconsolidated banks. E. N. T.

1227. Paris basin search opens. Anon. *Oil Gas J.*, 28.1.57, **55** (4), 137.—Following seismic work, a well is being drilled near Senelly *ca* 25 miles SE. of Orleans in the Paris basin. This is the first oil test in an exploratory project covering 7722 sq. miles. C. A. F.

1228. Two French wildcats hit. Anon. *Oil Gas J.*, 18.3.57, **55** (11), 106.—A deep test in the Parentis field in SW. France has found gas condensate in Lower Jurassic at *ca* 12,300 ft, which is below the established limestone pay at 7100 ft. The field is now producing over 25,000 b.d. from the shallower zone.

Near Dax, also in SW. France, Clermont 2 on test of Upper Cretaceous sandstone at *ca* 6300 ft produced 35° oil.

The single-well fields at Mothes, Lugos, and Lucats are producing 300, 300, and 70 b.d. respectively. C. A. F.

1229. New petroleum and natural gas occurrence in the Vienna basin. (In German.) H. Wiesender. *Erdöl u. Kohle*, 1956, **9**, 357–63.—The Austrian oil industry was returned by Russia in Aug 1955. The centre of the present Austrian petroleum production is the Matzen field. Of 3·67 million tons of crude oil produced in 1955 in the Vienna basin 2·87 million tons came from this field, and 75% of this from the Matzen sand. The predominant structures are Tortonian and Helvetian, and the most important oil bearer is the Matzen sand on the Tortonian base. The productive portion of the Matzen sand forms an anticlinal structure with its axis bearing WSW.–ENE. R. T.

1230. Microbiological investigations in the Debowiec territory. A. Luchter. *Bull. Polish Inst. Petrol.*, 1956, **6**, 3 (suppl *Nafta* (*Krakow*), 1956, **12**).—After the gas section of the Polish IP discovered the presence of methane in surface layers, microbiological work started aiming at the relationship between appearance of methane and disappearance of vegetation. Bacteria capable of feeding on methane were planted in specified points, and qualitative and quantitative results were obtained, leading to the conclusion that the method is suitable for discovery of seepages of hydrocarbons from below. M. S.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1231. New method indicates productive area. M. Milstein. *World Oil*, 1956, **143** (6), 113.—The proper interpretation of small measurable differences in vertical intensities in magnetic prospecting can indicate structural and stratigraphical variations in the area surveyed. These differences reflect the influence of localized features and form the basis of the method. The concept of " domains " of uniform magnetism is discussed, and the results are described of a reconnaissance survey of the Hainesville salt dome in Texas using this principle. C. A. F.

1232. Application of radioactive isotopes in geophysics of the oilfields. A. Kislow. *Nafta* (*Krakow*), 1956, **12**, 87–8.—New methods are described on the basis of Russian work. Radioactive isotopes are added to the mud or cement. This allows the discovery of cavities and also keeps a check on the work. The method is superior to the electrical method. 3 diagrams and 2 refs included. M. S.

1233. Science and technique in Soviet Union—geophysical work in the U.S.S.R. A. Kislow. *Nafta* (*Krakow*), 1956, **12**, 78–9.—A summary of papers presented by the Soviet delegation at the Rome Congress based on articles by Fiedinkij and covering post-war years. M. S.

DRILLING

1234. Safety in rigging up and tearing down. J. L. Muir. *Petrol. Engr*, 1956, **28** (11), B113.—Safety precautions which should be taken and the hazards involved in rig handling are discussed. For efficiency, teamwork and proper planning are essential, and inefficiency may lead to physical hazards. Safety equipment should be used as routine, and all operations must be supervised. 16 check points are given to limit hazards during the raising and lowering of derricks. C. A. F.

1235. Shutting off water zones in air drilling. W. F. Hower, J. Ramos, and H. J. Ayres. *Petrol. Engr*, 1956, **28** (11), B58–62.—If water-producing zones are penetrated during drilling, the water may be sufficient to produce mud and hence stick the bit, or in large quantities lower the efficiency of drilling generally. Types of water zones are cited and an account of research work into sealers recounted, none of which have yet proved completely adequate. E. A. G. H.

1236. Hydraulic couplings and torque converters in big rig drives. R. W. Colebrook. *Petrol. Engr*, 1956, **28** (11), B71–3.—The types and operation of hydraulic drives and their application to large rig transmissions is discussed. Comparison is made of the use of couplings and torque converters on the drawworks and mud pumps. E. A. G. H.

1237. Why are bit-design factors important? H. G. Bentson. *Oil Gas J.*, 24.12.56, **54** (86), 82.—The designs of bits for drilling in soft, soft to medium, and medium-hard formations are briefly described, with photographs of the different types of bit and bottom-hole patterns.

Soft beds require max gouging–scraping action, whereas medium-hard beds are best drilled with bits having also a chipping–crushing action. C. A. F.

1238. Practical hints for establishing optimal rotary drilling conditions. L. Szostak. *Nafta* (*Krakow*), 1956, **12**, 88–90.—The variables are pressure on the drill, No. of revolutions, correct shape of drill, and correct mud, both in relation to the formation traversed. All these variables and the quantity of mud pumped per hr are interdependent. The discovery of optimal conditions from the start of drilling should be done in the presence of highly qualified staff. M. S.

1239. Formation tester. R. Kruczek. *Nafta* (*Krakow*), 1956, **12**, 94–8.—Author describes with diagrams and operational details the construction of a tester devised by him. This contains a filter of porosity equal to the porosity of the formation and a hollow cyl which is lowered into the well at frequent intervals. This equipment brings up a sample of fluids present in the rocks. M. S.

1240. Variations in mud pit level—significance and use in drilling operations. E. J. Dower. *Petrol. Engr*, 1956, **28** (11), B151–62.—The main usage of such variations is to warn against impending blowouts and stuck drill pipe. A nomograph relating pit level change to change in hydrostatic head is drawn up. The effect of gas or liq incursion on mud pit level is also discussed. E. A. G. H.

1241. Prototype of a pH meter for drilling mud. T. Szura. **Synthesis of inhibitors and additives for lubricants.** H. Mosurski. **Determination of small quantities of aniline as oxidation inhibitor in turbine oils.** S. Urbanczyk. **Drying natural gas in stripping plants.** Z. Pomykala. *Bull. Polish Inst. Petrol*, 1956, **6**, 1–2 (Suppl *Nafta* (*Krakow*), 1956. **12**).—4 brief summaries: pH meter designed by Z. Zakrocki and T. Szura is a portable model without thermionic valves. Includes 2 dry batteries. It is working satisfactorily already. Oxidn inhibitors are made from turpentine and P_2S_5 and have a mol. wt. 350–500. Chlorinated turpentine gives a better product. Both are corrosion inhibitors as well. $(R–SO_3)_2Ba$ is a detergent oil additive in which R consists of 2 or 3 rings and a long side-chain. High-pressure additives are based on German wartime work. All additives are awaiting testing in special apparatus which is being built. Quantity of aniline is determined using $KBr–KBrO_3$ and making use of the formation of $C_6H_2Br_3NH_2$. Results are accurate within $-2{\cdot}7\%$ and $+0{\cdot}7\%$. Drying natural gas before it reaches the stripping plant will save the absorbent there. SiO_2 gel or activated alumina can be effectively used. M. S.

1242. Changes in muds during drying and grinding as determined by thermal analysis. J. J. Głogoczowski and M. Solecki. *Bull. Polish Inst. Petrol.*, 1956, **6**, 3–4 (suppl *Nafta* (*Krakow*), 1956, **12**).—Whilst work was being done on formulation and preparation of Polish muds, investigations were started on the extent of thermal changes in the loams considered which may occur during processing. These show that not only is there a loss of water (at 80° C and 140° C) but the minerals change to others of the same stoichiometric mol composition, but of different crystallographic nature, mainly montmorillonite. M. S.

1243. Selection of the right shape for joints in drill pipes based on fatigue strength. S. Karlic. *Nafta* (*Krakow*), 1956, **12**, 60–2, 90–4.—In connexion with an article published in *Nafta* (*Krakow*), Jan 1956 and with reference to papers in English and German, the author points out that the weakest spot in any drill-pipe system is the joint. The change in shape must be such as not to lead to the formation of cracks. These are caused by longitudinal extensions and contractions and by lateral swinging which, repeated, gives rise to fatigue. Work carried out by API is quoted extensively, as well as catalogues of various manufacturers. There is need for a fatigue testing machine in the Polish Equipment Workshops which—to achieve best results—will have to be operated in conjunction with pipe-making steel works. M. S.

1244. Slurry and suspension transport—basic flow studies on Bingham plastic fluids. W. M. Laird. *Industr. Engng Chem.*, 1957, **49**, 138–41.—A flow equation for a Bingham body in an annular pipe is developed. This equation requires numerical solution, but a simpler equation which is more convenient for practical applications is also given. Examples illustrate the inaccuracies that may be introduced by the latter equation. Pressure *v.* flow curves and velocity profiles are given for a Bingham body and a Newtonian fluid of the same visc flowing in an annular pipe. D. B. S.

1245. How 16 wells were drilled directionally. A. G. G. de Chastelain. *Oil Gas J.*, 7.1.57, **55** (1), 99.—A number of wells have been drilled in W. Canada recently involving controlled directional drilling and the use of directional surveys to determine the best deflection route. Data obtained from 12 of these wells in the Pembina and Joffre–Burbank fields are briefly discussed and costs are listed. C. A. F.

1246. Interpretation of radioactivity logs in gas-drilled wells. D. H. McLendon. *Petrol. Engr*, 1956, **28** (11), B63–79.—The lithology of the Mesaverde sediments of the San Juan basin in New Mexico can be determined within reasonable limits by the proper interpretation of radioactivity logs in gas-drilled wells, related to core analysis. It is stated that the procedure is applicable generally in similar sediments to establish: (1) porosity; (2) formation content; and (3) % fluid. The interpretation of radioactivity curves is discussed at length with the aid of diagrams. E. A. G. H.

1247. Gas drilling pays off in deep Delaware basin test. L. R. Baskin. *Oil Gas J.*, 11.3.57, **55** (10), 178.—The drilling history of a deep test in the Delaware basin is briefly described. Gas was used as a circulating medium from 5694 to 12,506 ft, resulting in considerable savings in drilling costs over conventional media, due to increased bit life and higher penetration rates. Drilling history and well head equipment are illustrated by diagrams. C. A. F.

1248. Drilling with air in the Rocky Mountains. N. J. Isto, S. G. Stiles, and S. C. Foster. *Petrol. Engr*, 1956, **28** (11), B100–5.—Initially reasons are given for the use of air, and then the air drilling procedures are described. Amongst the problems encountered were: (1) extremely hard carbonates and sandstones; (2) steep-dipped formations; (3) lost circulation zones; and (4) water-bearing sections. Savings on one well were estimated at $50,000. E. A. G. H.

1249. Over 100 wells, 140,000 + brl per day. Anon. *Oil Gas J.*, 31.12.56, **54** (87), 166.—Drilling operations by Shell offshore in NE. Lake Maracaibo, Venezuela, are described. These are in 3 blocks off the coast from Lagunillas and, up to Sept 1956, 100 wells had been drilled in the area, with a production of over 140,000 b.d. Most producers have been completed in Eocene sand lenses and in the N. block Miocene and younger rocks overly unconformably an Eocene horst.

Spacing has been on a 1200-m triangular grid and infilling on a 600-m grid is planned. Water depths range from 60 to 110 ft, and wells are drilled from platforms mounted on permanent foundations of steel with cement grouting.

Completion techniques, safety controls, and the oil gathering and disposal systems are briefly described. C. A. F.

1250. Core drilling on the Polar ice cap. Anon. *Petrol. Engr*, 1956, **28** (11), B106.—Core drilling is being carried out in Greenland on the 83rd parallel in order to obtain data on the ice cap which may provide information on past climatic conditions. Surface height is *ca* 7000 ft with temp averaging −20° C. 4-inch dia cores of the ice are being taken, using compressed air as a circulating medium. The rig is a Failing 314 core drill unit. C. A. F.

1251. Deep drilling technique in Germany. Z. Onyszkiewicz. *Nafta* (*Krakow*), 1956, **12**, 62–5.—Statistical analysis of drilling in W. Germany between 1951 and 1955 shows the trends in planning and policy. Brief mention of the various methods and equipment used shows that easy transportation allows the greatest number of jobs/rig/year. Actual drilling reaches 40–50% of the time on the job; great progress has been made in high speed drilling by application of high pressures. Coring has now become very successful. Turbo-drilling allows the hole to be straighter, since the power is applied at the rock and not transmitted from the turntable. For pulling out the string of tools, pulleys and gear-boxes are most essential; rotary drilling is driven by diesel engines of *ca* 200 h.p., whilst pumps are coupled to a source of power = *ca* 800 h.p. Electrical drive is being introduced. M. S.

1252. What those French turbo-drill tests show. J. O. Scott. *Oil Gas J.*, 11.2.57, **55** (6), 121.—Turbo-drill tests in France in 1956 showed penetration rates averaging 6 times that of conventional drilling. Penetration rate was found to be directly proportional to weight on bit and varied as a fractional power of the speed of rotation. Formations penetrated were fairly hard, consisting of hard marls and limestones. The equipment used and drilling conditions are briefly outlined, and a series of charts show the results of the tests. It is concluded that the French turbo-drill has a definite advantage in drilling medium hard formations, but in harder rocks bit wear might be a serious problem. 5 refs. C. A. F.

PRODUCTION

1253. Desirable pumping unit speeds. C. L. Coffmann. *Petrol. Engr*, 1956, **28** (9), B87.—Formulæ have been developed which enable pumping speeds to be determined when they are in phase with the natural frequency of sucker rod strings. Slonneger has shown that the natural frequency of a rod string is inversely proportional to the square root of the static elongation. Nomographs are presented to simplify the use of this relationship, and they may be used with tapered or non-tapered rod strings. 3 refs. C. A. F.

1254. Network model of porous media. III. Dynamic properties of networks with tube radius distribution. I. Fatt. *J. Petrol. Tech.*, 1956, **8** (7), AIMME Tech. Paper No. 4272, 164–77.—Studies have been made of relative permeability and relative electrical resistivity curves for a network of tubes of different radii by means of an analogue using electrical resistors. The curves obtained were similar to those for real porous media. It was concluded that the characteristics of these curves arise from the network structure of the porous media. The exponent n in Archie's relationship, $R = S_w^{-n}$, between wetting phase relative resistivity and wetting phase saturation, depends on network structure, not pore radius distribution. n falls from 4 to 1 as the number of channels joined to each channel increases from 4 to ∞. Porous media of uniform pore size will have identical relationships between relative permeability and relative resistivity and saturation, because these relative flow properties depend on pore geometry only. When the pore sizes are non-uniform at a given saturation the wetting phase relative conductivity will be greater than wetting phase relative permeability; the relative conductivity at a given saturation will be less than the relative permeability for the non-wetting phase. The average slope of k_g/k_o curves will be large for media with a large exponent for the relative resistivity relationship and small for media of low exponent. G. D. H.

1255. Increase fracturing efficiency. J. K. Henderson. *Petrol. Engr*, 1956, **28** (9), B74.—Fracturing efficiency can be increased by the use of a mud-dissolving acid, such as a mixture of HCl and HF. These dissolve or disintegrate clay minerals, and if used in front of the fracturing fluid it is possible to carry out the treatment at a lower injection pressure. Permeability around the well bore is increased, thus stimulating production. The technique is illustrated by a diagram. C. A. F.

1256. Single zone well completions. C. L. Rawe. *Petrol. Engr*, 1956, **28** (9), B40.—Every completion programme must have 4 common objectives: the exclusion of extraneous fluids, gases, or materials from the producing interval, the zone must not be damaged, the sizing of equipment for flowing or artificial lift and to accommodate future workovers, and the zone must be penetrated to the necessary depth. The choice of programme depends on the method of drilling, type of producing zone, type of reservoir drive, physical properties of the zone, probable life of well, stimulation method (if any), and possible corrosion problems.

Various types of completion are described with diagrams; these include open hole, and setting casing in and through formation. The selection and use of tubing, and the functions and types of packers, are also described. C. A. F.

1257. Jet perforator given a new wallop. Anon. *Oil Gas J.*, 7.1.57, **55** (1), 78.—A new shaped charge, the Dyna-Jet, on test from a 4-inch perforating gun, has shown that it provides more hole area and vol, and 16·8% deeper penetration than the current standard 4-inch charge. It is ellipsoidal in shape, and a steel barrier in the explosive charge, placed over the apex of the liner, deflects shock waves set up by the primer charge, which increase detonation rate and pressure. C. A. F.

1258. An experimental study of the influence of the chemical composition of electrolytes on the S.P. curve. M. Gondouin, M. P. Tixier, and G. L. Simard. *J. Petrol. Tech.*, 1957, **9** (2), AIMME Tech. Paper No. 4455, 58–72.—The quantitative use of S.P. logs generally assumes the electro-chemical component to be $-K \log R_{mf}/R_w$, K having the theoretical value corresponding to soln of pure NaCl. When relatively large amounts of salts other than NaCl are present in the formation waters, this relationship becomes inaccurate, and the same is true when gypsum-base or calcium chloride muds are used. Lab studies have been made of the effects of HCO_3, SO_4, Ca, and Mg on the S.P. deflection. The experimental results and techniques are described. The S.P. can be expressed approximately by S.P. $= K \log \frac{(a_{Na} + \sqrt{a_{Ca} + a_{Mg}})_w}{(a_{Na} + \sqrt{a_{Ca} + a_{Mg}})_{mf}}$, a_{Na} being the activity of the Na ion, a_{Ca} the activity of the Ca ion, etc. Interpretation charts show the relationships between the concn and activity of Na, and between the concn of Ca and Mg and $\sqrt{a_{Ca} + a_{Mg}}$. Examples of the use of these relationships are given.

However, the problem is usually not to get the S.P. from the composition of the fluids, but to use the S.P. to get the resistivity of the formation water. For this purpose the equivalent resistivity ratio is given by $\frac{(R_{mf})_e}{(R_w)_e} = \frac{a_w}{a_{mf}}$. Then S.P. $= K \log \frac{(R_{mf})_e}{(R_w)_e}$ with $K = 71$ at 75° F. Charts compare R_w and $(R_w)_e$, and R_{mf} and $(R_{mf})_e$. For high-salinity waters

a relationship S.P. $= K \log \frac{(R_{mf})_e}{(R_w)_e}$ is used with equivalent charts.

The theoretical principles involved in the investigations are outlined. G. D. H.

1259. Inventiveness in petroleum industry—removable hinged crown (drilling bit), equipment for extraction of small articles from boreholes, device for suspending well-bottom pump at chosen level. M. Ringler *et al.* *Nafta (Krakow)*, 1956, **12**, 110–11.—Detailed description of these inventions and improvements. M. S.

1260. Permissible gas production v. depletion of reservoir. W. Schiller. *Nafta (Krakow)*, 1956, **12**, 65–8.—Following pointers given by Kulczycki and Wilk, the author develops the theory of production linked to rising consumption and limited supply. The max flow of gas permissible must not damage the walls or cause fall-in. In one of the wells investigated, where formation pressure was 81·64 atm, gas velocity has been worked out by means of varying parameters representing permeability and area of the well and allowing for a max fall of pressure between formation and surface to be 5% of the former. M. S.

1261. Homogeneous fluid flow through consolidated porous media. R. T. Johnson and H. N. Dunning. *J. Colloid Sci.*, 1957, **12**, 68–79.—The purpose of the investigation is to determine the fundamental laws which govern fluid flow through petroleum reservoir rock. The flow of water, acetone, and 2,2,4-trimethyl pentane through alundum plugs, grids of intersecting capillaries in glass block, and capillaries with closed branches was studied.

It is concluded that small differences observed in permeability are probably caused by incomplete liq saturation. Fluid distribution, and therefore fluid saturation, is affected by the wettability of the surface; saturation in turn affects the permeability, and an apparent relationship between permeability and wettability can be obtained. Addition of electrolyte to the water did not alter the permeability values. H. C. E.

1262. Quantitative log analysis. Pt 5. How to get true resistivity from normal curves. R. G. Hamilton and P. Charrin. *Oil Gas J.*, 18.3.57, **55** (11), 121.—A series of 12 sets of simplified departure curves are presented. They can be used to determine true resistivity (R_T) of a single bed under the following conditions: bed thickness (e) between 10 and 33·3 ft, borehole dia 8 inches, invasion dia between 8 and 40 inches, resistivity of invaded zone not greater than 51 times mud resistivity (R_m), and resistivity of surrounding beds approx equal to R_m. R_m and e must be estimated fairly accurately. The charts were calc for electrode spacings of 16, 38, and 64 inches. The method of using the charts is described. C. A. F.

1263. Gas wells also respond to fracturing. H. E. David. *Oil Gas J.*, 25.2.57, **55** (8), 133.—Recent work has shown that good results have been obtained from fracturing gas wells provided sand conditions and problems are carefully studied and proper materials, equipment, and techniques are chosen. Results of the treatment in the Fort Smith–Spiro area of W. Arkansas and E. Oklahoma are presented, with case histories of 4 wells, and appropriate fracturing fluids are recommended for various types of pay. Thickened oil can be used for general purposes, and acid–oil emulsions, thickened water, and refined oil are used under specific conditions. The max economical injection rate should be determined; at least 5 brl/min is recommended. C. A. F.

1264. Secondary recovery at Eola goes deep, comes high. N. S. Morrisey. *Oil Gas J.*, 18.3.57, **55** (11), 124.—A combination water flood and gas injection project in the Eola field, Garvin County, Oklahoma, are briefly described. It is being applied to the S. flank of the structure, which is a faulted anticline. Reservoir is Bromide sand at *ca* 10,000 ft, and gas is to be injected high in the sand and water below the oil–water level. The field was discovered in 1947, and other pay zones occur. Average pay thickness is 89 ft in the unitized area, covering 700 acres, and porosity averages 13·6%. C. A. F.

1265. The Northwest's expanding natural gas and petroleum industry. G. S. Hume. *Canad. Min. metall. Bull.*, 1957, **50** (538), 80–3.—Discovery of the Leduc field in 1947 stimulated prospecting. Geological conditions in the Peace River area of Alberta and British Columbia favour gas and oil production and accumulation. In 1949 Pacific Petroleum Ltd discovered Fort St John Field, where well No. 4 showed great potential production. Revenue from production has been very small in the absence of substantial markets; this condition will continue until the West Coast pipeline is in operation. Incentives are limited by the high cost of northward exploration; the Alaska highway does not help much. The historical geology of the Prairie Provinces is described. The results of exploration, and future prospects are discussed. Gas production from the Permo-Pennsylvanian and Triassic has good reservoir horizons. The total pipeline gas available (Oct 1955) in B.C. and Alberta combined, is estimated at 3347 MMM.c.f. The Peace River area, particularly the B.C. part, is a predominantly gas area. This may be due to exploration. In the Buick Creek field gas is a predominant feature. The only producing oil wells in B.C. are in the Boundary Lake field. The economic benefits of the gas and oil discoveries will affect both the people and industry. Building of the 30-inch pipeline to deliver gas to the markets of B.C. and Pacific area, and to the U.S.A. is an extremely important and costly project. R. T.

1266. Current investigations of gas and oil content of drilling mud and drilling fines ("Hydrocarbon Well Logging") in Canada. (In German.) G. Schmitz. *Erdöl u. Kohle*, 1956, **9**, 382–6.—Hydrocarbon Well Logging has proved useful—especially in wildcat wells—on the American continent, where regions are vast—in part opened up—and knowledge of geological structures fragmentary. The method is introduced with success in known fields with complicated stratigraphic conditions. The instrumentation is described with which specialists determine gas, oil, geological formation, drilling depth, and lag time. The logs obtained are qualitatively valuable, but sometimes give quant indications of gas and oil. Economics are discussed. Improved processes and instruments will do justice to rising demands of the oil industry in view of rational and successful drilling activity. R. T.

1267. French search: reward for courage. Anon. *Petrol. Press Serv*, 1957, **24** (4), 122–6.—Search for oil in the French Union is discussed. This year should see the assessment of 3 recent fields in the Sahara. The newly-discovered small fields in the Gabon will be brought into production. Exploitation of the large Lacq gas field in SW. France will commence April 1957. Great interest in this region follows discovery of the Parentis oilfield. Exploitation in Metropolitan France and the Union aims at lessening dependence on Middle East oil and the economic burden. Shortage of technicians will be a major obstacle. Total expenditure in the current—the third—5-year plan (1956–60) is envisaged at Fr. 240 milliard, of which *ca* 70% is expected to come from State funds. This compares with Fr. 56 milliard and Fr. 113 milliard respectively, for the first and second 5-year plans. Against expenditure of Fr. 208 milliard during the 11 years 1946–56, tangible results achieved in terms of oil discoveries are proved reserves of *ca* 154 million metric tons in the French Union. Established gas reserves in SW. France are to be

added to this. The State has provided most of the capital, but private investment is growing. Jersey Standard, Caltex, Socony Mobil, Shell, and B.P. have an interest in the oil search in France; Royal Dutch/Shell participate in the Sahara, B.P. in Senegal. Estimates of France's future petroleum needs show that Metropolitan France will require 27·6 million metric tons by 1961—19 millions last year—consumption in overseas territories will rise from *ca* 3 million tons in 1955 to >6 millions in 1961. Production will rise, and new reserves of 100 million tons—including Sahara discoveries—may be established. In Metropolitan France $\leq \frac{2}{3}$ of sedimentary areas are covered by exploration permits, but only *ca* $\frac{1}{3}$ of the French Union's total sedimentary areas. Sahara production may reach 10 million tons/year from 1960, *ca* 5 million tons from Hassi Massaoud. The oil may be pipelined to the Algerian coast. Details are given of Sahara production, operations, and transport, with a location map.
R. T.

OILFIELD DEVELOPMENT

1268. Sahara–Texas for France? Anon. *Chem. & Eng. News*, 22.4.57, 60.—The French started the first systematic research for petroleum and minerals in the Sahara in 1952, and hope that by 1960 this source may supply $\frac{1}{3}$ of her petroleum needs. Oil has been found at Edgele and Hassi Massaoud, and natural gas near In Salah. The quoted quantitative estimates seem encouraging to such an extent that the laying of vast lengths of pipeline is being considered.
W. H.

1269. Gulf leaves Italy. Anon. *Oil Gas J.*, 28.1.57, **55** (4), 137.—Exploration by Gulf in Italy has been discontinued, but the Ragusa field in Sicily will be developed. Production from the field is now *ca* 18,000 b.d., and this is expected to increase with the recent completion of a pipeline to a refinery at Augusta.

2 wells were drilled and found commercial production near Alanno in E. Italy, but these have not been produced.
C. A. F.

1270. Sumatra blossoms out. Anon. *Oil Gas J.*, 1.4.57, **55** (13), 98.—The Minas field in E. Central Sumatra has been developed since 1949, and production is now *ca* 125,000 b.d. from the Miocene Telisa sand at *ca* 2500 ft. The structure is a NW.–SE. trending fold. Development of the neighbouring fields of Duri and Bekasap is planned. Duri was discovered in 1940, with Miocene sand pay at *ca* 800 ft, and Bekasap in 1955, with a pay at 3000 ft.

A 30-inch pipeline linking the new fields with the coast and a new sea terminal and road facilities are also planned.
C. A. F.

TRANSPORT AND STORAGE

1271. Completely mechanized pipeline welding. P. Reed. *Oil Gas J.*, 22.4.57, **55** (16), 104.—A simple practical low cost welding procedure is described which is practicable for yard operation under extremes of atm temp previously considered prohibitive for welding.
G. A. C.

1272. New sea-going pipe-laying barge has modern production-line principles. L. Resen. *Oil Gas J.*, 15.4.57, **55** (15), 112.—A $750,000, 260-ft vessel, the *Magic*, is described which can lay pipe in unprotected offshore waters in the Gulf of Mexico. The vessel, of 1000 tons, has welding, X-ray, and field print stations in production-line fashion.
G. A. C.

1273. Supervisory control goes local. P. P. Plovanich and E. E. Hogwood. *Oil Gas J.*, 8.4.57, **55** (14), 88.—Control over short distances for local station control at the Fort Laramie station of Service Pipe Line Co results in fewer operating personnel, lower operating costs, short pay-out, and ease of expansion. Diagrams show the station and its tankage, and the station electrical system.
G. A. C.

1274. The Trans-Iranian products line. Anon. *Petrol. Times*, 12.4.57, **61** (1557), 317.—Details of the Abadan–Teheran project are given, including preliminary survey, engineering specifications, pipelining, cathodic protection, pumping stations, and pipeline operation.
G. A. C.

1275. Problems in underground pipe design and in pipelaying. 1. N. W. B. Clarke. *Pipes and Pipelines*, 1956–7, **1** (3), 18–23, 25.—Engineering problems in pipe design in relation to load, surcharge load, pipe bed, vibration, soil disturbance, subsidence, submergence, temp, internal pressure, chem attack, and soil nature are discussed with numerous supporting diagrams.
R. T.

1276. Pipeline into Persia. Ten-inch products line from Abadan to Teheran. Anon. *Fluid Handl.*, 1957, 105–10, 120.—The existing line from Abadan to Ahwaz has been extended by 300 miles to Azna by Costain–John Brown Ltd.; the N. section of 200 miles from Azna to Teheran is being constructed by a French firm. An illustrated description of the construction of the central section, which has 4 pumping stations, is given, including details of quantities of materials used and schedules maintained. Some of the problems encountered are mentioned. The whole task was completed 4 months ahead of schedule. Capacity of the line (for petrol, kerosine, and gas oil) is 10^6 tons/year, which will be doubled later.
W. A. M.

1277. Nuclear propulsion of merchant ships. Anon. *Mot. Ship*, 1957, **38** (443), 18.—An economic study of atomic tankers was made for Norwegian shipowners. The size and speed of the nuclear-powered vessel which would give the max net return on invested capital was considered, and this return is compared with that of conventionally-powered vessels. The study included only ships equipped with thermal heterogeneous boiling (heavy or light) water moderated and cooled reactors.
D. K.

1278. Natural gas shipments. Anon. *Chem. Age*, 9.3.57, **77**, 416.—The shipment of natural gas in its liq form is discussed. Although this could be transported at atm pressure by severe cooling, certain snags arise which make this very difficult, and the construction of special tankers would be necessary. Again, unless the gas is very pure, corrosion problems will arise.
W. H.

1279. A mobile bunker-oil blender. Anon. *Mot. Ship*, 1957, **38** (443), 37.—A brief description is given of the Texas Co's proportioneer mobile bunker blender. It includes 2 positive displacement meters for measuring the residual and dist fuels, linked together via an infinitely adjustable variator and mechanical differential. The output differential operates a pilot-controlled hydraulic cyl which derives its power from the pressure differential across the blender, to position a blend or proportioning valve. The whole apparatus is mounted on a 4-wheeled trailer.
D. K.

1280. Heavy duty pumps for bunkering. Anon. *Mot. Ship*, 1957, **38** (443), 37.—A new Stothert and Pitt unit designed for an output of 500–700 tons/hr is briefly described. 2 photographs.
D. K.

1281. Economic aspect of packing in distribution of petroleum products. P. Lipka. *Nafta (Krakow)*, 1956, **12**, 69–72.—In Pt 2 the author deals with containers "on loan" to the consumer. These are steel drums suitable for liq, wooden barrels suitable for greases, steel bottles for liquefied gases, and sacking for paraffin wax. The use of steel drums for asphalt is possible, and careful treatment will enable such drums to be used more than once. General rules for keeping such containers in good condition are given in the article.

M. S.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1282. How to integrate three modern refineries into one better one. G. Weber. *Oil Gas J.*, 15.4.57, **55** (15), 104.—3 refineries in Central Michigan have merged facilities and thus greatly improved flexibility, economy, and product diversibility. A flow sheet shows integration of the 3 units' cat cracking, thermal cracking, and speciality naphtha and chemical plant. G. A. C.

1283. Fundamentals of mixing in petroleum refining. J. H. Rushton. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 87–102.—An analysis is made of the requirements for liq mixing in various refining processes such as blending of gasoline and lub oils, various treating and washing operations, extraction processes, air blowing, and the suspension of catalysis in liq. The mechanics of flowing fluid streams are described to show how mass flow and turbulence are generated and used to produce the effects required for the different processes. The characteristics of equipment used for mixing are discussed in terms of the type of fluid motion they produce, and some performance data are given. The most versatile and useful mixers are those with rotating propellers and turbines. Knowing the fluid motion best suited to the operation, and how to arrange a mixer to produce that motion, proper specifications can be made for refinery-size equipment.

(Author's abstract.)

1284. Need instruments? Make your own. Anon. *Chem. & Eng. News*, 8.4.57, 82.—At Whiting, Indiana, one section of Standard's engineering research department works full-time developing analytical instruments. A typical instrument is known as an "end point recorder," which automatically measures the temp at which the heaviest part of a petroleum fraction vaporizes. Other instruments include an automatic vapour pressure recorder, a continuous recorder of gasoline volatility, and a device that uses β-rays to measure hydrogen–carbon ratios. Some of the many advantages arising from such equipment are discussed, and the method of operation of one of the instruments is described. W. H.

1285. How to lick monitoring problems. Anon. *Chem. & Eng. News*, 25.2.57, 86.—Esso engineers at Baton Rouge were unable to buy the right kind of sample system components for: (1) the vaporization of light hydrocarbon samples in the propane–butane boiling range; (2) the removal of entrained solids from the flue gas of a cat cracker; (3) the removal of entrained water from liq hydrocarbon samples. Methods of overcoming these difficulties are described in detail. W. H.

1286. Practical application of combination processing. J. A. Beukers and H. P. Kelder. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 349–57.—The application of combination processing is not new in the petroleum industry. Basically, it involves integration of refining processes whereby these become interdependent. The application of the principle has been limited in the past, and only in the last few years are some articles appearing in the literature which indicate that combination processing is being utilized to a greater extent. The rapid development of improved and automatic instrumentation will undoubtedly have been an incentive for the increased application of combined interdependent processes. The advantage of this combination is reduced investment and operating cost, while slightly higher yields of saleable products are obtained through a reduction in losses and fuel consumption. An example of a fully integrated fuel products refinery is described in the paper. The refinery consists mainly of one unit—a fluid combination unit. It combines in one single unit dist of crude oil, thermal reforming of virgin naphtha, fluid cat cracking of heavy gas oil, stabilization of motor gasoline fractions, and direct blending of certain streams to finished products. The entire operations, which have been simplified by the use of a graphic panel, are controlled centrally. No unusual processing difficulties are encountered, while upsets in one section of the unit can generally be straightened out without undue difficulties in the other sections of the unit. Special care is recommended in the setting up of the design basis of a combination unit, while it is highly desirable to select the best available equipment in its construction and to apply modern instrumentation liberally.

(Authors' abstract.)

1287. Determination of chemical products in refinery effluents. (In French.) D. Giraud Desjuzeur and A. van Langermeersch. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 465–75.—The method described achieves the continuous individuation of the presence of certain cpds in process plant effluents by a colorimetric technique. A simplified recording colorimeter has been developed. The instrument includes an electron photomultiplying cell whose current output is sufficient to operate a recorder without requiring any intermediate amplification. This method has been used for the determination of phenol. The colorimetric reaction employed is the coupling of phenol with diazo-*p*-nitrobenzene chloride. To obviate the difficulty of cold storage of an instable reagent, the latter is prepared directly in the reacting medium by the action of *p*-nitroaniline chloride on sodium nitrite. The colour turns from yellow to orange, then to red, with the increasing phenol content. The response curve of the cell as a function of the wavelength is such that the current fluctuation due to colour change is high as compared with that due to changes in the effluent water's capacity. (Authors' abstract.)

1288. Report on deodorization of refinery effluents. I. McCallum, J. A. Shaw, C. H. S. Gill, and D. A. H. Peters. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 497–507.—In view of the extreme importance of minimizing air pollution at Fawley, a plant was installed as part of the new refinery construction to deodorize waste aqueous liq. Spent caustic soda and sulphide-bearing water present a serious odour problem, due to the intensity and carrying power of the smell. The system employed at Fawley for reducing air pollution from liq wastes consists of a combined neutralization and stripping of the spent caustic and H_2S bearing streams. The operation is carried out using hot boiler flue gas and steam. The CO_2 in the flue gas releases the sulphur cpds, which in turn are stripped by the action of flue gas and steam. Operation of the unit has been in the main satisfactory, and the odour of the effluent stream is reduced to a relatively innocuous level. This report describes the design and operation of the spent caustic deodorizer and discusses corrosion problems and other difficulties which have arisen since the start up of the unit. (Authors' abstract.)

1289. Air pollution problems and control. I. McCallum, P. G. Layzell, and R. A. Vere. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 491–6.—The Esso refinery in the U.K. is situated at Fawley on Southampton Water and is surrounded by the rural area of the New Forest with residential areas in the neighbourhood. It has, therefore, been essential in any expansion programme to take all reasonable precautions to avoid spoiling the local amenities in any way. Effective control over atm pollution has presented specific problems, and many of the measures taken to minimize air pollution were included in the basic design of the refinery units. Among these were: (1) the preferential use of gas for furnaces, and the provision of cyclones to remove solid particles from effluent gases; (2) design and operation of furnaces and stacks to prevent smoke; (3) exclusion of sulphuric acid treatment to minimize sulphurous fumes; (4) measures to prevent crude or partially refined products from releasing fumes to the atmosphere; (5) provision of a deodorizer for the treatment of spent caustic soda streams; (6) provision of a sulphur recovery plant to reduce the quantity of sulphur cpds being expelled. The above design considerations have been supplemented by an extensive control system to ensure that the measures taken are effective. (Authors' abstract.)

1290. Atmospheric pollution problems associated with the refining of Middle East crudes. A. W. W. Kirby. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 477–90.—In the introduction to this paper the author gives an account of the statutory measures for the control of atm pollution that exist in the U.K. The paper goes on to discuss the fundamental characteristics of the refining of Middle East crudes which may give rise to atm pollution. An account is given of those problems which were foreseen at the design stage of a major refinery in the U.K., together with the methods that were adopted at that time to solve them. Decisions were taken to recover H_2S and to convert it to sulphur, to install stripping columns for malodorous water streams, and to utilize regenerative treatment methods for gasoline and light hydrocarbons. High stacks were incorporated in the plant, as were open pumphouses (for safety measures). Mechanical seals were specified on pumps handling H_2S-bearing liq. The third section of the paper deals with the unforeseen difficulties that were encountered after start-up, and describes methods by which they were overcome, under the headings of crude oil and simple dist, cracking, treating and ancillary processes, combustion, and mechanical equipment. The fourth section of the paper deals briefly with sampling and analytical techniques. (Author's abstract.)

1291. Modernization of steam boilers in refineries. H. Duchan. *Nafta (Krakow)*, 1956, **12**, 105–6.—Modernization, although less effective, is cheaper than installation of new boilers. Details of modernization of one such boiler are given, together with its results in terms of quantity of steam produced and efficiency. M. S.

1292. Double-fired heater needs less tube area. Anon. *Chem. Engng*, 1957, **64** (3), 156–8.—A new process heater design developed by the Sun Oil Co for its Houdriformer units increases the average heat flux by 50% and also saves on maintenance cost and pressure drop. Construction of the heaters involves multiple pass tube banks sandwiched between radiation planes of horizontally-mounted burners. The burners, located at several elevations, fire in vertical planes parallel to and on both sides of the tube bank.
D. H. A.

1293. Optimum performance of wax filters. T. M. Jackson. *Soap, N.Y.*, 1957, **33** (3), 143.—Procedures are discussed for the filtration of molten natural waxes and the clarification of wax emulsions. Choice of plant filters and filter aids and costs are considered. G. A. C.

1294. £35 million to be spent on petrochemicals at Fawley. Anon. *Chem. Age*, 13.4.57, **77**, 635.—Esso Petroleum Co propose a new plant scheduled for 1 July 1958 and costing £22 million, part of which is to produce butadiene and ethylene as by-products to their gasoline production. Further neighbouring plants will be built by Monsanto and I.S.R. to utilize these by-products. It was proposed to make ethylene by the " steam cracking " process, whereas the butadiene was to be obtained by a dehydrogenation process, developed by Esso and employing a secret cat. W. H.

1295. The reconstruction of the refineries at Bari and Leghorn. U. Galati. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 27–52.—The big refinery plants built around 1936–37 by the A.N.I.C. (Azienda Nazionale Idrogenazione Combustibili) to process Albanese crude and low-grade crudes by high pressure cat hydrogenation were very badly damaged by the war. The Leghorn refinery, already hard hit by bombardments, was dismantled during the German occupation. The Bari refinery, while having suffered little or no damage during the war, was nevertheless faced with problems arising out of a production flow-chart wholly different from that for which it had originally been built. The author first describes the events which led to the construction of the 2 refineries, and the production flow-charts adopted at that time, and goes on to speak at some length of the various phases in reconstruction and modernizing carried out in 1949–53 and of some projects still in the course of completion. He then gives some information concerning the present operation of the 2 refineries with the type of plant and production processes adopted. (Author's abstract.)

DISTILLATION

1296. Some recent developments in fractional distillation. A. P. Colburn, J. A. Gerster, and C. Pyle. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 71–86.—A better understanding of the factors affecting design and operation of plate columns has resulted by consideration of the individual mass transfer rates in the gas phase and in the liq phase. The important design and operating variables affect column operation differently, depending upon the controlling transfer rate. Quantitative relationships are shown for prediction of plate efficiencies as a function of the physical properties of the system, the gas and liq rates, the liq depth, and the tray layout. Of the many recent developments in design of vapour–liq contactors, one of the most widely used is the sieve plate. A comparison is made of allowable throughput rates and plate efficiencies for sieve and bubble-cap trays.
(Authors' abstract.)

1297. Precision and high vacuum distillation. (In German.) E. Keundecke. *Chem. Z.*, 1957, **81** (8), 239–44.—A review of modern methods of high vacuum dist. P. J. K.

1298. Design for physical equilibrium. J. O. Osburn. *Chem. Engng*, 1957, **64** (3), 278–82.—The properties of 3-component vapour–liq equilibrium relationships are discussed. The data can be represented on triangular diagrams, by a system of x–y diagrams, or by plotting dist lines. The construction of diagrams on a solvent-free basis, of importance in extractive dist, is described. The application of Raoult's Law and equilibrium Ks to ternary mixtures are also described.
D. H. A.

1299. News of rectification technology. (In German.) E. Kirschbaum. *Chem. Ing. Tech.*, 1957, **29**, 159–60.—A brief review of recent developments in rectification technology. The article deals with bubble and sieve plates and with packed columns, together with a note on high vacuum dist.
P. J. K.

SOLVENT EXTRACTION AND DEWAXING

1300. The influence of the pressure on filtering rate in dewaxing. A. F. Orlicek. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 135–40.—A better understanding of the factors affecting design and operation of filters, especially continuous filters, has resulted from consideration of the theory of filtration. The mathematical aspect of the theory of filtration is developed in view of the fact that in wax filtration the cake consists of extremely soft, easily deformed particles. The influence of consolidation of compressible filter cakes on the resistance of filter cakes has been investigated, with the result that, for mathematical reasons, a max filter rate at an optimum pressure may be due only to processes taking place in the boundary layer of the filter, but not in the filter cake itself. (Author's abstract.)

1301. Arrangement of cold reflux for rectification equipment. F. Sikora. *Nafta (Krakow)*, 1956. **12**, 98–100.—Petroleum spirits (benzene fractions) suitable for use as extraction solvents which are graded as 65–90, 70–100, and 80–120 are all obtained by rectification of raw gasoline. The production of this solvent is rising, and it has doubled itself between 1950 and 1955. In 1951 Häckmann's unit with cold reflux was put up. The article describes how this unit operates and how it has been brought on stream. Data of production are tabulated. M. S.

CRACKING

1302. Possibilities of obtaining sulphur-resistant cracking catalysts from inland montmorillonitic clays. I. Orsic. *Nafta (Yugoslavia)*, 1957, **8** (2), 37–45.—Possibilities are examined for obtaining from inland montmorillonitic clays cat resistant to sulphur for cracking heavy oil fractions. For obtaining such cat the procedure of selective removal of the chemically-bound iron from the montmorillonite structure is applied. Tests have been made with *ca* 5 g of sample of the lab apparatus, which is shown schematically. Samples were previously calcined in inert or reducing atmospheres at 600°–800° C, and afterwards they were treated at *ca* the same temp with nitrogen containing hydrogen sulphide. The produced iron sulphides are leached away with normal hydrochloric acid.

Various factors influencing the removal of iron were tested, *e.g.* the temp of the procedure, gas composition at the calcination and sulphidization of clays, gas velocity in the reactor, duration of the procedure, and the condition of leaching of the produced iron sulphides. Besides these, the influence of the removal of iron on the cat activity of cat is examined.

By this experimental technique, the max removal of iron from the lattice was reached (71·4%) when the calcination and sulphidization was carried out at 750° C, and the gases passed over the clay with a velocity of 75 cm³/min for 90 minutes. The best leaching of iron sulphides was attained with normal hydrochloric acid at b.p. of the suspension.

As the tests show, removal of iron from the structure lattice of montmorillonite does not affect the cat activity of natural cat. (Authors' abstract.)

1303. Fluid cracking catalyst contamination. J. E. Connor, Jr. *et al.* *Industr. Engng Chem.*, 1957, **49**, 272–82.—A test for metal contaminants in oil stocks is described in which the way that contaminants are laid on the cat is simulated and the contaminated cat tested for activity and product distribution. The test was used on known oil–metal naphthenate soln, and the effect of the metal was found to vary considerably, depending on the concn and type of metal and the method of deposition, the activity and degree of deactivation of the cat caused by the deposition, and the mol. wt. of the oil and oil-solubilizing groups on the metal. These variables are explained using modern concepts of cat behaviour and structure. D. B. S.

1304. Gas-oil cracking by silica–alumina bead catalysts. M. F. L. Johnson, W. E. Kreger, and H. Erickson. *Industr. Engng Chem.*, 1957, **49**, 283–7.—The activity and selectivity of silica-alumina bead cat was investigated in a fixed-bed lab gas-oil cracking unit. Reductions in the particle size or increases in the pore size and pore vol were found to improve both selectivity and activity. D. B. S.

1305. Catalyst mixing patterns in commercial cat cracking units. E. Singer, D. B. Todd, and V. P. Guinn. *Industr. Engng Chem.*, 1957, **49**, 11–19.—Cat circulation patterns were determined in 3 commercial cat cracking units using a radioactive isotope labelling technique. The choice of isotopes and safety precautions are fully discussed, the isotopes used being both γ-emitters—scandium-46 and cerium-144. Techniques for rapid injection and sampling of the tagged cat are described. D. B. S.

1306. Stack loss of catalyst from commercial cracking units. D. B. Todd and W. B. Wilson. *Industr. Engng Chem.*, 1957, **49**, 20–4.—The rates of loss of fresh cat from 3 commercial units were determined using an isotope labelling technique. D. B. S.

1307. Regenerative platinum-catalyst reforming of naphthas. J. K. Roberts, E. W. Thiele, and R. V. Shankland. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 251–60.—Ultraforming is a new fixed-bed reforming process developed by Standard Oil Co (Indiana). The distinctive features of this process are the use of a platinum cat at relatively low pressure, and a special regeneration technique. Low operating pressure is used because it gives better yields of gasoline and by-product hydrogen, permits a higher ceiling O.N. without excessive loss of yield, and results in higher effective cat activity. Low-pressure operation is particularly advantageous with low-naphthene feeds because it favours production of aromatics from paraffins and provides more hydrogen for recycling. Periodic regeneration of the cat is required because coke accumulates more rapidly on the cat at low pressure and causes more rapid declines in gasoline yield and cat activity. Regeneration also improves flexibility with regard to feedstocks and processing conditions, and permits recovery from operating upsets. Since removal of coke by conventional regeneration techniques does not completely restore cat quality, a special regeneration technique was developed which goes beyond mere coke removal, completely restores the cat to fresh condition, and ensures a long ultimate life. Commercial Ultraformers in operation, or under design or construction, have a combined capacity of *ca* 100,000 b.d. These units will process a wide variety of naphthas and produce reformates of 90–100 O.N., unleaded. (Authors' abstract.)

1308. The relative effect of deactivating agencies on the performance of silica–alumina cracking catalyst. N. J. H. Small, P. H. S. Kirkaldy, and A. Newton. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 261–76.—Fresh synthetic cat added daily to the inventory of a commercial F.C.C. unit suffers a rapid loss of activity. In an attempt to assess the relative contribution to this loss from the major known deactivating agencies, the separate effects of heat, steam, trace metals, and carbon were studied in relation to cat activity, selectivity, and surface properties. The extent of thermal deactivation is dependent on both time and temp, and is always accompanied by pronounced changes in the surface properties of the cat and by a small loss of water. In lab tests only a severe thermal treatment deactivated fresh cat to a level comparable with equilibrium cat. Steam accelerated thermal ageing, but at plant temp it did not cause the

deterioration of test samples to a level comparable with that of equilibrium cat. Lab experiments showed that trace metals had an appreciable effect on the performance but no very considerable effect on the surface properties of partially deactivated cat. A loss of activity and of selectivity in the presence of heavy metals were indicated by reduction in gasoline yield and by a large deposition of carbon and an increase in the gas–gasoline ratio. Sodium caused a deterioration in activity without affecting selectivity, and the results obtained were consistent with the carbonium-ion theory of cat cracking. The deposition of carbon was found to increase with cat activity. The removal of carbon improved the activity of equilibrium cat by a few units. It was concluded that high temp were mainly responsible for the final state of equilibrium cat. On this basis a mechanism is proposed in which unrecorded high temp may occur on the surface of particles during the removal of large quantities of carbon. As a result of these high temp, trace metals may become trapped in the body of the cat, and their effect on cat selectivity is then appreciably reduced. (Authors' abstract.)

1309. Improvement of activity and selectivity of solid catalysts. E. W. Nagelstein. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 339–47.—It is shown in this work, by the examples of alumina and alumina-containing cat, that many commercial cat—despite their apparent homogeneity—are in fact mixtures of differently active and selective components. This is experimentally proven by the preparation of homogeneous fractions of these cat. Their homogeneity depends—apart from other known factors—essentially on the strict control of the contact times between the fresh precipitate and the precipitation soln. These contact times have been modified within large limits, and thus cat of defined and predicted activity and selectivity have been obtained. It has been possible to find out for what reasons the same alumina differs greatly in its activity and selectivity if used for various cat. Aluminas having predicted activity and selectivity have been prepared for a certain number of chemical reactions. The suitability of aluminas in composed cat, especially in cracking cat, has been examined. A way for improving the preparation of cracking cat, as well as synthetic and natural cat, is indicated. In the experimental part, the continuous manufacture of aluminas with increased activity and selectivity is described. A simple test method for alumina or silica gel-containing cat, permitting general conclusions on their cat behaviour, is discussed. (Author's abstract.)

1310. The influence of catalytic cracking and other catalytic processes on the production of Italian refineries for domestic and foreign markets. G. de Sanctis. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 319–38.—The paper summarizes the present situation of total motor gasoline yield, average octane level, and process facilities according to the requirements of Italian markets. A typical case is considered in detail, showing how Middle East crude is fractionated in various straight-run basic cuts by atm and vacuum dist, then is converted into finished products by upgrading some select cuts to high octane gasoline by cat cracking and reforming processes. Italian refineries do not generally have adequate facilities for such purposes, due to circumstances of construction or post-war reconstruction. Because of the above-mentioned requirements of the Italian market it is foreseen that new cat units shall be installed with caution, with the purpose of raising as necessary the octane level, without unduly increasing the gasoline yield. An appendix includes nomograms permitting the determination and comparing of yields and characteristics of products by various process sequences.

(Author's abstract.)

1311. The production of town gas by the catalytic gasification of petroleum oils. J. B. McKean. *Inst. Petrol. Rev.*, 1957, **11** (124), 90.—The technical problem is discussed of conversion of a fuel with comparatively high ratio of C to H to one of lower ratio, development of suitable cat, and design of prototype commercial plant. Method and control of process are described and tables show thermal balances. Design of future plants discussed. G. A. C.

1312. Gas mixing characteristics of a fluid bed regenerator. A. E. Handlos, R. W. Kunstman, and D. O. Schissler. *Industr. Engng Chem.*, 1957, **49**, 25–30.—Gas mixing characteristics in a cat regenerator were investigated using a helium tracer. The residence time distribution in the dense phase resembled that of a well-mixed vessel; the distribution of gas was not, however, completely uniform, and it appeared that regions near the walls were ineffective for regeneration. D. B. S.

1313. Dealkylation of ethylbenzene. M. Nager. *Industr. Engng Chem.*, 1957, **49**, 39–41.—It was shown that ethylbenzene could be dealkylated over equilibrium cracking cat at *ca* 1000° F to lower aromatics. Steam was found to increase the proportion of ethylene and reduce the amount of coke formation and also the proportion of ethane and methane in the gas produced.

The major reaction appeared to be the cracking of ethylbenzene to benzene and ethylene, together with smaller amounts of toluene. The amounts of benzene and toluene produced in some of the runs represented a conversion efficiency of 89 mol %. D. B. S.

1314. Computer built into cat cracker. Anon. *Chem. Engng*, 1957, **64** (3), 190.—For the first time, a programmed general-purpose analogue computer has become an integral element of oil refining process control at the Belot refinery of Esso in Cuba. More efficient operation and tighter process control of a cat cracker are obtained by means of the information provided by the computer at hourly intervals. The computer logs 101 process variables, calculates 11 operating guides, and totalizes and records every 24 hr the major process quantities. D. H. A.

1315. Advances in fluid catalytic cracking. E. J. Gohr. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 293–304.—Cat cracking has become one of the most important processes in the petroleum refining industry. During the post-war period, total cracking capacity increased from 1,300,000 to 4,200,000 b.s.d. In this expansion, fluid cat cracking has been the process most widely installed. At present, 69% of the total cracking capacity in the U.S.A. is fluid; outside the U.S.A., 78% is fluid. Contributing significantly to this position of the fluid process were design and process advances made during the post-war period. This paper summarizes the post-war growth of the fluid cracking process, and discusses the main design and process advances made in the period. A combination of design, mechanical, and process improvements substantially lowered fluid plant investments and operating costs. The new designs are considerably simpler and more compact, reflecting simplified cat recovery, more compact cat circulation systems, smaller vessel sizes, and generally improved mechanical features and plant layout. As a result, steel requirements are now approx ½ of those used in the original designs. From a process standpoint, 2 of the more important advances were the cracking of heavy fractions and recycle cracking when processing heavy feedstocks. These process advances have led to better utilization of crude, giving significantly more gasoline and heating oil at the expense of heavy fuel oil. Further improvements in the process can be expected for the future. In the meantime, a steady and continued growth of fluid cracking capacity is anticipated to further replace obsolete thermal capacity, to accommodate increased recycle operations, and to keep pace with the industry's ever-increasing crude runs.

(Author's abstract.)

1316. Recent development in TCC cracking. E. V. Bergstrom, V. O. Bowles, L. P. Evans, and J. W. Payne. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 305–17.—This paper discusses the improvements made in the Thermofor Catalytic Cracking (TCC) process since 1951. These developments make possible substantial increases in reactor and kiln capacities while still maintaining the high cracking efficiency inherent in the TCC process. The authors discuss the improved mixed-phase feed technique currently being used in several commercial units. The causes and effects of heavy metals poisoning are discussed, showing how metals are selectively removed from the system with the cat fines. Data are presented for processing a wide range of charge stocks to produce a variety of products. In conclusion, the authors discuss the ability of the TCC to fit any practical refinery processing scheme. They present refinery yields for 4 typical processing plans based on a 30,000-b.d. refinery processing Mid-Continent crude.

(Authors' abstract.)

1317. The Houdriflow catalytic cracking process to-day. H. D. Noll, J. C. Dart, and R. E. Bland. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 277–92.—This paper describes the present status of the Houdriflow moving bed cat cracking process. Emphasis is placed on recent mechanical improvements made and commercial experience achieved during the past few years. The major mechanical details which are discussed and illustrated with diagrams include: (1) reactor vapour disengager; (2) air inlet system; (3) kiln cooling coils; (4) cat withdrawal system; and (5) cat lift system. Typical results are given for 2 commercial Houdriflow installations illustrating the flexibility of the process in handling highly different charge stocks. In addition, detailed yields are presented for one of the refineries when cracking at a conversion above 99%. It is pointed out that maintenance cost on Houdriflow units is low, due to the almost complete absence of erosion and corrosion of the equipment. Typical figures are presented to illustrate the manpower requirements for the turn-around of an 11,000 b.s.d. unit, with a breakdown into crafts. The total Houdriflow capacity in operation and under construction is 252,000 b.s.d. (Authors' abstract.)

1318. Platforming—present and future. V. Haensel and J. F. Walter. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 233–40.—During the last 4 years UOP Platforming has become a major cat process in the petroleum industry, being second only to cat cracking in capacity. The early operations were designed solely for the upgrading of straight-run stocks into high octane gasolines. Later developments led to the utilization of Platforming for the production of specific aromatic hydrocarbons and aviation gasoline blending components. The present paper deals in part with the effect of feedstock composition upon the reactions taking place in Platforming. Highly paraffinic stocks are upgraded primarily through dehydrocyclization and selective hydrocracking of the paraffins. Highly naphthenic stocks, on the other hand, are improved mostly through the conversion of naphthenes to aromatics. A discussion of operating variables and a summary of typical commercial operations are given. The combined Unifining–Platforming operation is presented as a means for upgrading cracked and coker gasolines as well as high sulphur straight-run stocks. In this case, the hydrogen produced by the Platforming operation is utilized in the Unifining step to eliminate cpds of nitrogen, sulphur, and oxygen as metallic impurities from the feed, in addition to the saturation of olefins. Since Platforming produces substantial amounts of hydrogen as a by-product, the Unifining operation can readily be used to upgrade higher boiling fractions, the combined operation thus providing for a more economic and efficient utilization of the crude. (Authors' abstract.)

1319. Fluid Hydroforming. C. W. Tyson. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 225–31.—At the present time, 126,000 b.d. of Fluid Hydroforming plant capacity is being installed in the U.S.A. and throughout the world. Fluid Hydroforming is a continuous regenerative process for producing 90–100 O.N. gasoline from virgin naphthas. This process makes use of the fluidized solids technique and employs a molybdena–alumina cat in microspherical form. The cat is both cheap and rugged, and not susceptible to poisoning by sulphur or water. The products are essentially sulphur-free. The selectivity of the cat to desired products does not drop off with continued use. Yields are 95 clear Research O.N. C_5 + reformate are almost identical with a highly paraffinic charge stock, but slightly lower for the Fluid Hydroforming process when treating a more naphthenic type feed. Feeds containing cracked stocks may be reformed with excellent yields by the Fluid Hydroforming process, without pretreatment of the feed for olefin saturation or sulphur removal. (Author's abstract.)

1320. The Autofining process: the production of low sulphur diesel oils. J. W. Hyde and F. W. B. Porter. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 193–202.—Considerable advances have been made in the application of the Autofining process, a cat desulphurization process developed by the British Petroleum Co Ltd. These advances have been made possible by the development of an improved cat and by changes in operating technique which enable diesel fuels to be produced with less than 0·1% wt sulphur content from high sulphur feedstocks. An extensive examination of the process variables on the lab scale has been made and the process proved by operations on a 12-b.d. pilot plant. Designs for a commercial unit have been prepared.

(Authors' abstract.)

HYDROGENATION

1321. Hydrogenation of crude oils in Germany, especially combined with cracking. M. Pier. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 516–30.—The 4 hydrogenation plants in W. Germany have a crude oil topping capacity of over 3 million tons/year, and an oil residues hydrogenating capacity of 1 million tons/year. In 1953 they produced *ca* ⅓ of the gasoline, and ¼ of the diesel oil consumed in W. Germany. Middle East and German crude oils, which are rich in hydrogen and sulphur, were used as raw materials. Since the fuel oil consumption in Germany is comparatively low, these crude oils must be entirely converted into fuel. The fuel demand in Germany is for equal quantities of gasoline and diesel oil. Originally, the topped residues of crude oil were hydrogenated in the liq phase and in the 2-stage vapour phase. For both these phases, procedures and cat which simplify the process and improve the quality of the products have been developed in recent years. Progress has been achieved especially by combining hydrogenating plants with thermal and cat cracking plants. Cracking produces limited quantities of gasoline and diesel oil from raw materials rich in hydrogen at low costs. The cracked middle oils and cracked residues rich in aromatics, whose hydrogen content has been reduced, can be either made suitable for recracking or processed directly to high-grade fuels by hydrogenation. The combination of cracking and hydrogenation produces high yields and, even from raw materials of high sulphur content, products of an excellent degree of refining, offering the well-known advantages of cat treatment with hydrogen. Widely varying combinations are being adopted on an industrial scale with much success, with the result that the fuels produced meet all demands made upon their quality. (Author's abstract.)

1322. Petroleum refining with hydrogen. W. E. Bradley, G. W. Hendricks, and H. C. Huffman. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 509–16.—Process uses of hydrogen in the petroleum industry are reviewed with particular emphasis

on refining type hydrogenation. After a consideration of the early work on coal hydrogenation and the development of heavy oil hydrogenation in the U.S.A., the discussion continues with considerations of: (1) production of aviation gasoline components; (2) production of triptane; (3) isomerization of light naphthas; and (4) the new and growing field of desulphurization and upgrading of naphthas, solvents, kerosines, gas oils, lub oils, etc., by the use of hydrogen. Although the potentialities of hydrogenation as applied to oil refining have long been recognized, it has had little commercial use by the petroleum industry because of the high cost of facilities and hydrogen for the processing. Now, with the availability of increasing amounts of hydrogen as a by-product from cat reforming and the appearance of processes which can economically upgrade a wide variety of stocks under relatively mild conditions, hydrogenation as a refining process appears to be on its way towards becoming an important tool for the petroleum refiner. (Authors' abstract.)

ALKYLATION

1323. Blitzing alkylation problems. Handling acid. L. Resen. *Oil Gas J.*, 8.4.57, **55** (14), 93.—Some typical problems are discussed regarding corrosion and safety factors in acid handling, including acid pump corrosion, handling acid, and operating an acid system. G. A. C.

ISOMERIZATION

1324. Chemical conversion by isomerization and dehydrogenation with Catforming. M. J. Fowle, R. D. Bent, and B. E. Milner. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 241–50.—The role of isomerization as a specific cat function in the field of paraffin, naphthene, and aromatic chemical production is reviewed. The relative importance of isomerization, dehydrogenation, and dehydrocyclization for octane improvement is also presented, together with the behaviour of the products of these reactions in automotive engines. (Authors' abstract.)

CHEMICAL AND PHYSICAL REFINING

1325. Some aspects of gasoline treating processes with special regard to sulphur problems. J. W. Le Nobel. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 391–8.—This paper discusses some aspects of the refining of gasolines, with special regard to sulphur problems, by various treating processes, using chemicals or aq soln thereof at normal or slightly elevated temp. First, a survey is given of some reasons why gasolines have to be refined and of the components or contaminants which are responsible for the undesirable properties. The importance is stressed of a detailed analytical study to determine which components should be removed and to enable a choice to be made for each particular case of the most efficient and economical treating process. This requires not only dependable methods for the analytical determination of such components, particularly for sulphur cpds, but also a good knowledge of the behaviour of each individual group during the various treating processes. Finally, the most important treating processes available at present for the sweetening and desulphurization of gasolines are reviewed in the light of the aspects mentioned, and some of their merits and demerits are discussed. It is also shown how in certain cases remarkable refining results can be obtained by an effective combination of treating processes. (Author's abstract.)

1326. Theoretical and technological research on the desulphurization of light petroleum distillates. V. Berti *et al.* *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 203–24.—After examining the influence of the various classes of sulphur cpds on the O.N. (clear and leaded) of gasolines, the thermodynamic and kinetic aspects of the decomposition of sulphur cpds are discussed. The elimination of sulphur cpds from petroleum light dist, by low pressure thermocatalytic decomposition on alumina-base cat, has been experimentally investigated. Particular study was devoted to the relationship between the efficiency and life of alumina-base natural and synthetic cat and their characteristics (structure, surface area, pretreatment conditions, formation of carbon deposits on the cat), as well as to the relationship between the results of desulphurization, the type of feedstock, and the influence of the basic operating conditions (temp and space velocity). The advantages of the cat desulphurization over the various liq-phase processes are also dealt with. Finally, a number of practical data are given, concerning desulphurization carried out in the lab or on a commercial scale, employing natural and synthetic alumina-base cat. (Authors' abstract.)

1327. Desulphurization of petroleum products of high sulphur content. M. Krupa, H. Masiarczyk, and J. Palczewski. *Nafta (Krakow)*, 1956, **12**, 72–6.—General review of the methods available, followed by list of those used in Poland. Also a mention of cat method with introduction of hydrogen from outside or using hydrogen from dehydration of *cyclo*-paraffins. M. S.

SPECIAL PROCESSES

1328. Fischer–Tropsch synthesis in South Africa. (In German.) W. Herbert and H. Tramm. *Erdöl u. Kohle*, 1956, **9**, 363–7.—The refinery of the Sasolburg, Fischer–Tropsch works of S.A. Coal, Oil and Gas Corpn Ltd. (Sasol) went on stream in Autumn 1955, and is to be in full production during 1956. South Africa possesses an abundance of ash-rich, non-coking coal suitable for power fuel synthesis. The plant is designed for the power fuel and org-chem industries. The latest processes incorporated are discussed with supporting illustrations. Coal production—mechanized—is cheap. Included are houses for personnel and water piped from the Vaal river. The effluent is biologically treated. The Sasol Co's policy appears to be, first, production of basic and intermediate products, leaving the finished products to private enterprise. R. T.

1329. Distribution of products obtained in Fischer–Tropsch synthesis with iron catalysts. (In German.) E. Weingaertner. *Erdöl u. Kohle*, 1956, **9**, 368–77.—The influence of hydrogenation H_2 on the structure of synthesis products is treated. A distribution law is found for paraffin hydrocarbons by utilizing the polymerization function. C-fraction vol are present in inverse proportion to the sq of the hydrocarbon numbers, independent of the abs amount of hydrogenation H_2. Their abs amount is obtained by multiplying with the hydrogenation H_2 val. The min methane—an exception—formation, as the first member of a series, is determined, and its influence on higher paraffin hydrocarbon formation discussed. Paraffin distributions can be calc from simple gas analysis data. A similar law is advanced for olefin distribution. Formation of lighter olefins is favoured in contrast to higher olefins, apparently as a result of the lighter hydrogenation of the higher olefins. Quant data are given for calculating olefin distribution. Olefin formation is essentially a radical polymerization, superposed by a weaker C_2H_4 polymerization. Part of the polymerization olefins—proportional to the hydrogenation H_2 brought by the cat—are hydrogenated. CH_4 formation results at least to over ½ of the hydrogenation H_2. Variation in higher paraffin formation with increasing CH_4 formation is shown. A procedure is given for calculating the total olefin vol and the distribution of the converted CO vol transformed into hydrocarbons on paraffins and olefins. Extensive tables and charts are given. R. T.

1330. Refining low temperature tar acids with ion exchange resins. E. A. Depp and M. B. Neuworth. *Industr. Engng Chem.*, 1957, **49**, 182–5.—Butyric acid and tar bases may be efficiently removed from low temp tar acids by treatment with strong base and strong acid resins. The exchange was investigated in a lab unit, and the rates of adsorption and equilibria involved were found to permit high throughput and efficient utilization of the total capacity of the resins.

D. B. S.

1331. Methylstyrene—a case study in spent acid catalyst treatment. N. Federgreen and A. J. Weinberger. *Industr. Engng Chem.*, 1957, **49**, 46–8.—The waste product from the manufacture of methylstyrene contains large amounts of both mercury and sulphuric acid. The waste may be hydrolysed and stripped with superheated steam to recover mercury and toluene in quantities which pay for the treatment. The stripped acid is sufficiently concentrated for it to be used in fertilizer manufacture. A projected commercial scale waste acid treatment plant is described. D. B. S.

1332. Sulphonation with sulphur trioxide—petroleum lubricant raffinates. E. E. Gilbert and B. Veldhuis. *Industr. Engng Chem.*, 1957, **49**, 31–8.—The production of sulphonates from petroleum lubricant raffinates by sulphur trioxide is compared with the older method using oleum. A considerably higher yield of sulphonate and a lower yield of acid sludge were obtained after one treatment with the air-diluted trioxide vapour, and even better results were obtained if the same quantity of vapour was used for several successive treatments. Liq trioxide was found to be less efficient than the vapour and the sludge: sulphonate ratio was higher. Reaction times varying between 8 and 55 minutes and temp between 55° and 90° C were investigated. The sulphonates produced varied between light and dark in colour and the sludge consistency between mobile and thick, depending on the lub oil used. Colour may be improved by a treatment during or after the sulphonation with hexane, sulphur dioxide, recovered oil, or ethylene dichloride. D. B. S.

1333. Direct mercuration of benzene. K. S. McMahon and K. A. Kobe. *Industr. Engng Chem.*, 1957, **49**, 42–5.—The mercuration of benzene was carried out at temp between 85° and 110° C using mercuric acetate. Increasing the benzene: mercury mol ratio was found to favour monomercuration and retard dimercuration. The effects of variations in the reaction time and temp and also the presence of water and acetic anhydride were also investigated. Both the mono- and dimercuration reactions were found to be reversible.

D. B. S.

1334. Preparing catalysts in the laboratory. Various. *Industr. Engng Chem.*, 1957, **49**, 240–87.—11 papers. Subjects include general techniques of cat preparation; methods for producing cat in various shapes and forms; the effect of preparation on the chemical composition at the surface, the crystal structure, surface area, pore size, and the degree of dispersion of the cat, etc., and hence the activity, selectivity, and stability of the cat; cat contamination. 2 papers of particular petroleum interest are abstracted elsewhere.

D. B. S.

1335. Extractive crystallization with urea in petroleum refining. A. Champagnat, J. Laugier, Y. Rollin, and C. Vernet. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 53–70.—Since the addition of urea to normal paraffins gives rise to crystalline adducts, it enables an extremely selective separation of these hydrocarbons from the petroleum fractions. However, the separation of the bulk of the crystals from the non-adducted hydrocarbons presents a difficult problem. In a semi-industrial unit, this problem has been solved by using a special solvent and carrying out the separation by decantation and washing. The use of the process in combination with a topping plant simplifies the redistillation step of the washing solvent. The semi-industrial unit produces normal paraffins with a view to studying their commercial applications, which are listed. It has also made possible the study of further applications of the extractive crystallization: improvement of the O.N. of straight-run and reformed motor spirits, improvement of the pour point of gas oils, and the freezing point of jet fuels.

(Authors' abstract.)

1336. New process for refining petroleum products. A. Gislon and J. M. Quiquerez. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 181–91.—The paper describes a new process for refining petroleum products. This consists in oxidizing the mercaptans by air at room temp in the presence of chelate cpds, such as the cobalt complex of Schiff's bases derived from salicylic aldehydes and diamines, which are known as commercial products by the name of Co-Ox, Salcomine, etc. The chelate is dissolved in cresol or methanol and the process is carried out preferably in a neutral medium. All petroleum products can be treated by this process, whatever their origin or mol. wt. 2 technical procedures have been developed. The first is suitable for products rich in mercaptans; the process is carried out by contacting the product to be refined with a hydroalcoholic dispersion of the chelate. Standard refinery equipment, including mixers and settling tanks, is suitable for this purpose. The second procedure consists in adding chelate, in cresol soln, to the product to be processed; sweetening then takes place during storage. The latter procedure is suitable for products of low mercaptan content, either on account of their origin or previous processing. Sweetening is followed by filtering on acid salt, which imparts the decoloration and stability to the end product. Chelate consumption is 1 g to every 8–12 g of oxidized sulphur, according to the type of mercaptans and the products processed. (Authors' abstract.)

1337. A pilot plant employing a novel process for the urea extraction of hydrocarbons. L. N. Goldsbrough. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 141–53.—The conventional separation, by filtration, of adducts of urea and straight-chain hydrocarbons presents some practical problems if a feedstock of high straight-chain content is being processed. The paper describes an alternative approach to the purification of straight-chain hydrocarbons by urea extraction through which, by incorporation of surface-active agents and inorganic salts in aq urea soln, filtration can be avoided. It has been shown that this method can be successfully operated on a pilot-plant scale. The 2 types of approach are compared, and it is concluded that they should be regarded as complementary rather than competitive. (Author's abstract.)

1338. Selective propane deasphalting. J. Mnich. *Nafta (Krakow)*, 1956, **12**, 19–20.—Brief outline of theory of the process which has been introduced in Poland in 1954. The details of consumption of power and water are given.

M. S.

1339. The Hoechst continuous coking process. H. Krekeler. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 381–90.—Various reasons are adduced for the different ways in which the production of chemicals from petroleum has developed in the U.S.A. and in Germany. The characteristics of the most important processes already known for the production of olefins are outlined. The lines of thought which led to the development of the Hoechst continuous coking process are described. (Author's abstract.)

1340. Fluid coking of residua. A. Voorhies, Jr. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 359–80.—A new coking

process, called " Fluid Coking," is the latest application of the fluidized-solids technique. The Standard Oil Development Co is the originator and licensor of this new process, which was developed to meet the acute need for a simple, rugged, continuous coking process. The Fluid Coking process employs no cat; it depends upon the heat and surface area provided by a circulating stream of finely-divided coke particles. The apparatus looks something like a fluid cat cracker; it has a burner vessel and a reaction vessel and the necessary standpipes and transfer lines to accomplish the circulation of fluidized coke between the 2 vessels. The fluidized coke is continually formed in the process, and is partly burned to supply heat. Fluid Coking can successfully handle the lowest quality and the shortest residua produced by modern vacuum dist, and also the very poorest grades of petroleum residua, including asphalts and thermal cracking coal tars. Excellent liq yields are obtained from these various feeds with a minimum of by-product gas and coke. The gas-oil product is satisfactory for cat cracking feed; and the coke product is suitable for fuel as well as special uses. Affiliates of the Standard Oil Co (New Jersey) are already engaged in commercialization of the process.

(Author's abstract.)

METERING AND CONTROL

1341. Aerofoil gas and liquid meter. Anon. *Fluid Handl.*, 1957, 103–4.—The Aerofoil unit for flow measurement in pipes operates by differential pressure resulting from its characteristic shape. By altering its angle relative to the pipe axis and the position of the orifice on the periphery, a range of flows of 1 : 120 can be measured. Power loss ≪ with orifice plate or venturi tubes, and the equipment is easily installed and can be withdrawn for examination and cleaning, if necessary, and replaced through a small hole without shutting off the flow. W. A. M.

1342. Processes for level measurement and control. (In German.) W. E. Frede. *Chem. Ing. Tech.*, 1957, **29**, 250–4.—A comprehensive review of the methods available for the control and measurement of liq levels. P. J. K.

1343. A look at electrical valve operators. G. F. Brockett. *Oil Gas J.*, 22.4.57, **55** (16), 108.—Various types of electrical valve operators now in the market are reviewed and fundamental design problems considered. Control valve operators (both direct drive and hydraulic) and amplifier systems are discussed. G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

1344. Liquid–liquid equilibria of ternary systems consisting of two hydrocarbons and a solvent. Y. L. Gladel and J. Durandet. *Rev. Inst. franç. Pétrole*, 1957, **12**, 130–2.—Further list (*cf.* Abs. **1361**, 1956) of 45 new equilibria, published in 1956. 4 new solvents (dimethylformamide, γ-valerolactone, 2,4-dimethylsulpholane, ammonia) appear. V. B.

1345. Generalized correlation for the effect of pressure on isobaric heat capacity of gases. A. H. Weiss and J. Joffe. *Industr. Engng Chem.*, 1957, **49**, 120–4.—The curves presented are based on data calculated from the Benedict–Webb–Rubin equation. Experimental data show that the correlation is more accurate than previous correlations and that it may be used for nitrogen and oxygen as well as hydrocarbon gases. D. B. S.

1346. Correlating vapour pressure and other physical properties. D. F. Othmer *et al.* *Industr. Engng Chem.*, 1957, **49**, 125–37.—An equation, a nomogram, and constants for 500 organic cpds are given. They may be used to yield data on solubilities of gases and liq, adsorption, absorption, vapour pressure equilibrium, chemical reaction rates, equilibrium flash vaporization values, and relative volatilities and activities. Methods for determining the constants are included. D. B. S.

1347. Study of heat transfer by radiation in the heater. (In French.) M. Delpech, H. Maurin, and C. Monnot. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 103–33.—Experiences have been carried out in 2 different refinery heaters in order to evaluate heat transfer distribution in the so-called radiation area of the earth. In addition to conventional measurements of the crude temp and pressure in different points of the coil, a total radiation pyrometer and a new type of wall calorimeter have been employed. In these conditions, it has been possible for the authors to evidence the role of a number of variables influencing hearth control. Obtained data may be of great help in improving refinery plants' thermal efficiency or, in some cases, their refining capacity. (Authors' abstract.)

ANALYSIS AND TESTING

1348. Ring analysis of mineral oil fractions by means of nomograms, using kinematic viscosity, refractive index, and density. J. Cornelissen and H. I. Waterman. *J. Inst. Petrol.*, 1957, **43** (398), 47–56.—Nomograms are given which enable the average number of aromatic and naphthenic rings/mol to be calculated. Results are in good agreement with those derived from the *n–d–M* method. 2 refs. C. B.

1349. Infra-red absorption analysis in the petroleum industry. 3. The applications of infra-red analysis. R. Quarendon. *Petroleum, Lond.*, 1956, **19** (11), 439–42.—So far the applications have been limited, in general, to the examination of comparatively simple substances. They will play an increasingly important part in the automatic control of processes, however, where the problem of continuous analysis of process streams is facilitated. The main requirements of such instruments will be sensitive control without instability, provision for storage of data, and trouble-free operation in service. E. A. G. H.

1350. Diesel combustion study by infra-red emission spectroscopy. W. T. Lyn. *J. Inst. Petrol.*, 1957, **43** (398), 25–46.—The spectra of various fuels burning in a compression-ignition engine are recorded. It is shown that the fuel burns with a diffusion flame during the main combustion period. Pyrolysis of the fuel under high pressure appears to be a major factor in diesel combustion. The apparatus used is described, and gas oil and gas oil with propane added to the air intake were the fuels used. 16 refs, 5 pages of discussion. C. B.

1351. Apparatus for the determination of the explosion limits of vapour–air mixtures of combustible liquids. (In German.) G. Micus and B. Taranczewski. *Chem. Ing. Tech.*, 1957, **29**, 275–7.—A very compact glass apparatus is described for the determination of the explosion limits of vapour–air mixtures. A stream of air is saturated by bubbling through the liq and is passed into the explosion chamber. The mixture in this chamber may be subjected to a spark passed between 2 platinum electrodes. The whole apparatus is maintained at a

given temp. The use of the apparatus is described, and the results compared with values taken from the literature.
P. J. K.

1352. Microestimation of aniline point in gasolines and substitution of aniline with other polar solvents. (In German.) R. Fischer and H. Moser. *Erdöl u. Kohle*, 1956, **9**, 377–80.—Microdetermination of the crit mixing temp of 2 liq is carried out by heating in a closed capillary tube. This enables the max an. pt. (max of miscibility gap diagram) to be determined rapidly—10–15 minutes—without measurement, weighing the 2 components, and loss of volatile cpds, also with dark oils. For gasolines—in place of aniline—15 of 65 tested liq were found suitable. Of these the following 7 were used in these tests: acetonylacetone, benzyl cyanide, butanediol, diethyl sulphate, dipropyleneglycol, methoxyacetic acid, ethylenechlorhydrin. These were tested with a large No. of mixtures of pure paraffins with aromatics and naphthenes from 0 to 30%. Results were favourable. R. T.

1353. The determination of sulphur trioxide in flue gases. I. R. A. Mott and K. Parramore. *J. Inst. Fuel*, 1957, **30** (194), 123.—Modifications made to the Corbett-Flint method of SO_3 determination are described and result in improved repeatability, so that concn as low as 1 p.p.m. can be estimated with reasonable accuracy. The modified method is being applied in an investigation on the effect of various factors on the production of SO_3 in a coke-fired domestic boiler. Preliminary results suggest an increase in the concn of SO_3 with increased rate of combustion. 7 literature refs.
D. K.

CRUDE OIL

1354. Sulphur in Yugoslav crude oils. D. Tarjan, E. Knezevic, and M. Beros. *Nafta* (*Yugoslavia*), 1957, **8** (1), 6–9.—The authors give data about the content of sulphur and hydrogen sulphide in Yugoslav crude oils and discuss the influence of the sulphur content on the quality of the obtained refinery products. (Authors' abstract.)

GAS OIL AND FUEL OIL

1355. The radiation from flames in a small-scale oil-fired furnace. D. K. Holliday and M. W. Thring. *J. Inst. Fuel*, 1957, **30** (194), 127.—Flame emissivity and temp have been measured along the length of a turbulent jet diffusion flame in a small experimental furnace for flames from 14 liq hydrocarbon fuels. The average flame emissivity depends on both the carbon to hydrogen wt ratio and the average b.p. of the fuel. The soot concn was measured along the axis of the flame for 5 of the fuels. The specific luminous emissivity was found to agree well with values obtained at Ijmuiden. The axial soot concn is higher in the small furnace than in the Ijmuiden furnace for a given fuel at an equivalent distance along the flame. It is thought that the shorter mixing and combustion time allows the soot to survive relatively longer in the small furnace. 5 literature refs. D. K.

1356. Economical burner for liquid fuel. Z. Schiller. *Nafta* (*Krakow*), 1956, **12**, 100–3.—A burner like this based on the Laval atomizer is described with drawings. It is designed for economy in firing boilers. M. S.

1357. Filterability of fuel oils during winter. Z. Stepek and S. Urbanczyk. *Nafta* (*Krakow*), 1956, **12**, 49–52.—For fuel oils crudes of low paraffinic content are required. Cloud point is not a sufficient test to determine their suitability. Their filterability can be determined in the lab by means of the apparatus illustrated, devised by the Polish IP. Another piece of apparatus designed to simulate actual conditions of use is also shown. Tests were carried out using both, and the effect of additives like Paraflow has been investigated. Several results are tabulated, but it must be mentioned that in the actual conditions of atm temp at which filtration is impeded, fuel oil would freeze on the walls of the fuel tank and keep the rest of the oil above that temp. Thus the lab test is more severe than practical conditions require. M. S.

LUBRICANTS

1358. Lubricant specifications. 1. E. G. Ellis. *Sci. Lubric.*, 1956, **8** (6), 14–21.—The nature and intention of specifications is briefly discussed, and some objections on the part of suppliers to too-rigid specifications are indicated. The main British organizations issuing lubricant specifications are enumerated, B.S. 210, covering lub oils, is considered in some detail, and the SAE classification of lubricants by visc is outlined and discussed. J. G. H.

1359. Effect of molybdenum sulphide as high-pressure addition to roller bearing grease. (In German.) W. W. Kullmann. *Erdöl u. Kohle*, 1956, **9**, 380–2.—The effect of small % additions of MoS_2 to high-pressure lub greases is investigated. Under suitable high pressure MoS_2 passes from the lub grease to the metal surface, where it remains and improves abrasive conditions. With high temp, or long running times at low pressure, this effect is not attained. With bearing surface improvement by MoS_2, emergency running characteristics appear, which maintain lubrication temporarily, and prevent abrasion on short failure of the lub grease. R. T.

1360. Continuous percolation of lubricating oils. A. O. Pukkila, H. W. Shea, J. W. Bartholomew, and R. B. Killingsworth. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 169–80.—The first commercial unit for percolation of lub oils by the "Thermofor Continuous Percolation" process has been put into operation at the Coryton refinery of Vacuum Oil Co Ltd. A description of the process and equipment, together with representative commercial operating data on yields and decolorizing efficiency, is given for a range of typical lub oil base stocks. (Authors' abstract.)

1361. High temperature bearing operation in the absence of liquid lubricants. S. S. Sorem and A. G. Cattaneo. *Lubric. Engng*, 1956, **12** (4), 258–60.—Use of present-day liq lubricants in high-speed anti-friction bearings would appear to be rapidly approaching useful limit, and other means of facilitating operation would appear to be necessary. To this end the operation of ball-bearings at speeds of 10,000 rev/min at temp up to 600° F without lubrication was studied under varying environments. The equipment and procedure employed are described. Results obtained indicate that operation in a blanket of reducing atmosphere, which could be a mixture of air and hydrocarbon vapour, together with pretreatment of bearings with conventional EP lubricant, could be maintained in the absence of normal lubrication for periods up to 60 hr without evidence of impending bearing failure. J. G. H.

1362. Boundary lubrication studies of typical fluoroesters. R. C. Bowers, R. L. Cottington, T. M. Thomas, and W. A. Zisman. *Lubric. Engng*, 1956, **12** (4), 245–53.—Boundary lubricating and wear-preventive properties of fluorinated diesters synthesized from aliphatic dibasic acids and nearly completely fluorinated alcohols are measured in the "stick–slip" apparatus and 4-ball machine at temp from 77° to 400° F. Rubbing surfaces employed include hard steel, soft steel, and bronze, and *bis*-(2-ethylhexyl) sebacate was used as a reference standard. Frictional properties of the 2 classes showed very little difference, with fluoroesters showing better wear-preventive properties, which were still further improved by the addition of 2% tricresyl phosphate. J. G. H.

1363. Measurement of extreme-pressure properties of lubricants. Supplementary report of Special Committee of ASTM Committee D-2 on Petroleum Products and Lubricants. P. A. Asseff, H. Levin, H. G. Sprague *et al.* *Bull. Amer. Soc. Test. Mat.*, 1956, (216), 25–8.—Progress is reported in the cooperative Timken testing of greases and in the development of liq standards, of substantially pure chemicals, for standardizing the Timken apparatus. J. G. H.

1364. American Society of Lubrication Engineers. Annual Meeting. Abstracts. *Lubric. Engng*, 1956, **12** (2), 135–40.—Abstracts of papers presented at the Annual ASLE Meeting, Pittsburgh, 4 April 1956, are presented. J. G. H.

1365. Plant safety as related to lubrication. (Panel discussion.) D. W. Dodson. *Lubric. Engng*, 1956, **12** (2), 117–22.—Points covered include the value of centralized automatic lubrication, use of less-flammable hydraulic fluids, evils resulting from lack of, or over-lubrication, and use of accident records as a basis for accident prevention programme. J. G. H.

1366. M.E.R.L.'s lubrication research. Anon. *Sci. Lubric.*, 1956, **8** (11), 14–17.—Work at the Mechanical Engineering Research Laboratory on fretting corrosion, pitting of high-speed ball bearings, lubrication, and cutting oils is briefly described, with notes on the use of electron microscope, radioactive tracers, and the rear-axle rig. J. G. H.

1367. Friction and lubrication. Anon. *Sci. Lubric.*, 1956, **8** (6), 25–8.—Abstracts of papers presented at the conference on lubrication and wear organized by the V.D.I. at the Technische Hochschule, Darmstadt, 20–22 March 1956. J. G. H.

1368. Lubrication at the 9th International Congress of Applied Mechanics. Anon. *Sci. Lubric.*, 1956, **8** (10), 26–8, 40.—Summaries of papers having lubrication interest presented at the 9th International Congress of Applied Mechanics held in Brussels, 5–13 Sept 1956. J. G. H.

1369. Estimation of the activated domestic clay in bleaching process of the mineral lubricant oils. M. Krajcinovic, M. Filajdic and M. Sila. *Nafta (Yugoslavia)*, 1957, **8** (1), 1–5.—In Yugoslavia, imported adsorbents have been used in bleaching lub oils. The authors have examined samples of the domestic clays from Bednja, previously activated by the Metan plant from Kutina. They concluded, after extensive lab research, that the examined samples showed satisfying results in the bleaching process of the lub oils in comparison with activated clay (Nadal) of German origin.
(Authors' abstract.)

1370. Nature and performance of some inorganic base greases. W. H. Peterson, J. B. Accinelli, and A. Bondi. *Lubric. Engng*, 1956, **12** (2), 95–101.—The history of inorganic gelling agents in lub greases is briefly reviewed and the basic principles involved in gelling discussed in detail. High-temp and water-resistant characteristics of inorganic base greases are explained in relation to their gelling properties, and the wheel-bearing and glass jar corrosion tests are set out in detail. J. G. H.

1371. Evaluation of lubricating grease compatibility. A. L. McClellan and S. R. Calish. *Lubric. Engng*, 1955, **11** (6), 412–17.—Difficulties occurring in service through the mixing of greases with different soap bases resulted in the initiation of an investigation of compatibility. Consistency, dropping point, and ASTM Grease Leakage tests were carried out both for individual greases and for mixtures, and provided indications of mixture instability, which was accentuated by heating. These results were correlated with anti-friction bearing machine tests, which revealed marked incompatibility in sodium–calcium, barium–lithium–calcium, and lithium–sodium–calcium mixtures. J. G. H.

1372. Grease lubrication dispensing equipment, its operation and application. L. R. McDonald. *Lubric. Engng*, 1955, **11** (6), 402–4.—Lever-type guns and air-operated drum pumps are briefly described, together with centralized lubrication systems, both manual and automatic types, and the value of centralized systems in economy of lubricant and manpower, in the reduction of down-time, and in the promotion of industrial safety is indicated. J. G. H.

1373. New lubricating oil conditioner. Anon. *Sci. Lubric.*, 1956, **8** (6), 29–30.—Dry and wet type systems for conditioning steam turbine lub oil manufactured by Menrow Ltd are described and illustrated, and results of tests of the equipment at Battersea Power Station reported. J. G. H.

1374. Glass lubricant in the extrusion of steel. J. S. Sejournet and J. Delcraix. *Lubric. Engng*, 1955, **11** (6), 389–96.—The extrusion process is briefly described, and problems encountered in the extrusion of steel are outlined with special reference to lubrication. Basic extrusion theory is reviewed, and the application of molten glass as lubricant is described with its function in the units used in the process. J. G. H.

1375. Some experiments in the lubrication of stainless steel. 1. G. D. Jordan. *Sci. Lubric.*, 1956, **8** (8), 14–19.—The increasing use of stainless steels as journal materials has focused attention on the need for more data on the friction, temp, and wear characteristics of bearing materials and for improved mineral oils to ensure satisfactory lubrication. Initial data are presented of an investigation of the wetting properties of a range of additive-type paraffinic base mineral oils on a series of stainless steels. Procedures and results so obtained are set out in detail and are interpreted as confirming the extensive use of olein compounded oils for cold rolling stainless steel. J. G. H.

1376. Some unusual conditions encountered in the lubrication of rolling contact bearings. T. W. Morrison. *Lubric. Engng*, 1955, **11** (6), 405–11.—Effective operation of rolling contact bearings calls for the co-ordination of bearing design, lubricant selection, and awareness of operating conditions to be encountered. The effect of operation at very low speed and heavy load on lubricant visc requirements is discussed in detail, with illustrations of the results of using oil of too low a visc. Results of varying greases used in bearings subject to fretting corrosion are set out, and investigations of relative effectiveness of mineral oils and synthetic fluids showed the latter as markedly reducing bearing life. J. G. H.

1377. Pressure drop across metallic filters. Anon. *Sci. Lubric.*, 1956, **8** (7), 14–17.—A progress report on work being carried out at Fulmer Research Institute to ascertain the relationship between pressure drop across a filter and other variables such as velocity of flow, dia of filter, and kin visc of the lubricant. Test apparatus and procedure used are described, and work carried out with small dia filters provided evidence of some relationship. Further work is intended using larger dia filters employing higher velocities of flow. J. G. H.

1378. Taking the confusion out of wheel-bearing lubrication. P. V. Toffoli. *NLGI Spokesm.*, 1956, **20** (6), 32–3.—Significant contributions to the solution of wheel-bearing lubrication problems during the past 5 years are summarized, leading to the development and publication of the NLGI "Recommended Practices for Lubricating Automotive Front-Wheel Bearings." J. G. H.

1379. Common denominators for automotive chassis greases. T. G. Roehner and E. L. Armstrong. *NLGI Spokesm.*, 1956, **20** (2), 28–31.—Criticism is directed at some of the criteria currently used in the evaluation of automotive chassis

greases, and details are presented of functional test-equipment used in the Socony Mobil Laboratories, comprising a chassis constant load grease tester, chassis cushioned shock load tester, and a vibrating front end suspension tester.
J. G. H.

1380. Some notes on the lubrication of agricultural tractors. 1. Transmission. A. C. Smith. *Sci. Lubric.*, 1956, **8** (11), 19–24.—Transmission and clutch systems are briefly described with notes on their lubrication requirements. The function of transmission lubricant as hydraulic medium is discussed, together with factors in oil selection, topping up, oil-change procedure, and transmission flushing. J. G. H.

1381. Evaluation of crankcase lubricants for radial gas engines. D. W. Sawyer, M. D. Keefer, E. M. Kipp, and R. W. Shaw. *Lubric. Engng*, 1956, **12** (3), 183–92.—Details are presented of an investigation by the Aluminium Co of America of the operating characteristics of a series of crankcase oils comprising low and medium V.I. naphthenic oils, straight and oxidn-inhibited high V.I. mineral oils, and H.D. det oils meeting Spec 2-1043, for use in radial gas engines. Screening tests with Lauson engines were used to determine bearing corrosion tendencies, ring sticking, carbon and varnish deposits, sludging, and oxidn stability, and were followed by full-scale engine tests in the 2-cycle Nordberg gas engines. Correlation between Lauson and full-scale tests left much to be desired, and a tentative specification developed calls for visc at 100° F 600–700 (S.S.U.), at 210 65 min, V.I. 80 min, flash 390° F, pour point 10° F max. Procedures employed and results so obtained are set out in detail. J. G. H.

1382. Some lubrication requirements of automatic transmissions for passenger cars. C. G. Tresidder. *Sci. Lubric.*, 1957, **9** (1), 21–3.—A major factor in the development of the automatic transmission has been the possibility of using one type of fluid in year-round service, as evident by the wide employment of the General Motors Automatic Transmission Fluid Type A specification and the Armour Institute qualification AQ-ATF-101. Desirable properties covering visc, friction and wear reduction, oxidn resistance, and compatibility are briefly discussed and salient servicing points indicated. J. G. H.

1383. Planned collection of used lubricating oils (for regeneration). K. Cichy. *Nafta* (*Krakow*), 1956, **12**, 103–4.—Repeated use of regenerated oils is still of great importance to the Polish economy. It is essential that those entrusted with collection of these oils should keep the various grades separate.
M. S.

1384. Production of Lux lubricating oil from Wielopole crude. R. Cigala. *Nafta* (*Krakow*), 1956, **12**, 76–8.—Lux lub oils have very high V.I. and are made from non-paraffinous raw material after Barisol refining. Thanks to an idea submitted by "rationalizers" (improvers and small inventors), crude with intermediate wax content can now be used for the manufacture of Lux lubricant. To bring the pour point below −5° C the following procedure is adopted: (1) dist to produce heavy oil sp. gr. 0·925, visc 0·0° E at 50° C, pour point 10° C, fl. pt. 137° C, containing 4·8% wax of m.p. 52° C—yield 11·75% of the crude; (2) vacuum dist to produce oil of visc 24°–26° E/50° C containing 4·0% wax of m.p. 54·5° C; (3) this is mixed with "minus-filtrate" of similar properties, and the lot is then refined with cresol. The resulting lubricant has visc 11°–12° E/50° C and V.I. = 57; (4) acid refining which follows and the addition of 0·3% of Paraflow produce "Lux 10." This has a pour point of 13° C, *i.e.* somewhat higher than the best grades of this lubricant; on the other hand, its corrosion characteristics are better than those of other Lux grades. M. S.

1385. White oil manufacture. V. Biske and A. Cluer. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 1–26.—Highly refined colourless lub oils, employed for specialized lubrication, food processing, and pharmaceutical purposes, are consumed in the U.K. to the extent of *ca* 15,000 tons/year. Such oils are manufactured by oleum refining of selected raffinates. To produce medicinal oil, raffinate obtained from a suitable dist by extraction with 200% SO_2 is treated with 60% wt (in **4** dumps) of 20% oleum, followed by neutralization and clay contacting. Overall yield of B.P. oil is 55%. Refining, as indicated by usual inspection tests, is virtually complete after *ca* 35% oleum addition, but further treatment is required to meet the pharmacopœia colour and carbonizable substances tests. Separation of acid and oil after contacting is effected by centrifuges, also employed for separating alcoholic lye from oil after intermediate and final neutralizations. Sulphonic acids, mainly derived from the first treatment cycle, are a valuable by-product; yield of these is *ca* 15% (as 50% soap) from medicinal oil. Alternative methods of white oil production are briefly mentioned. Testing of white oils is considered, especially with reference to carbonizable substances and stability to sunlight; indications are that the latter may be predictable by results of exposure of oil to a carbon arc.
(Authors' abstract.)

1386. Spray and drip methods of applying lubricant to wire rope. D. B. Burroughs. *Lubric. Engng*, 1956, **12** (3), 193–5.—Earlier notions that sufficient lubricant was incorporated in wire ropes during fabrication have given place to an appreciation of the advantages to be derived from regular lubrication, and light-bodied lubricants are replacing the heavy-bodied type formerly recommended. Advantages of the former, especially when employed in a drip or spray installation, are outlined and examples of equipment used described. J. G. H.

1387. Fibre lubricants in the woollen industry. "Kemmek." *Sci. Lubric.*, 1956, **8** (10), 29–30.—The functions and desired properties of wool oils are briefly summarized, and factors leading to the use of blended oleins are set out. Obstacles to the extended use of mineral oils are indicated and the need for further development work stressed. J. G. H.

BITUMEN, ASPHALT, AND TAR

1388. Fundamentals of bitumen blowing. J. M. Goppel and J. Knotnerus. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 399–413.—Petroleum residues are frequently blown with air to modify their physical and rheological properties and so to adapt them to special applications. This oxidn process is carried out on a large scale; at a conservative estimate 4 million tons of residue are annually blown to a wide variety of bitumen grades. Since relatively little is known about the chemistry of the blowing process, an investigation was initiated to clarify the reactions involved and to establish to what extent each contributes to the overall modification of the properties of the material. First, a set of analytical methods was worked out, which, in combination with spectroscopic evidence, led to the elaboration of an oxygen balance accounting for the oxygen present as water and carbon dioxide in the waste gases and the oxygen chemically bound in various functional groups in the bitumens, both with respect to the total amount of oxygen in the injected air. With the aid of these methods the chemistry of the blowing process could be investigated. It was found that all the oxygen taken up by the bitumen can be accounted for by the formation of hydroxyl, carbonyl, acid, and ester groups; no ether oxygen could be detected. Among these functional groups the esters are particularly important; they not only account for *ca* 60% of the oxygen in the blown bitumen, but also link up 2 different molecules, and thus contribute to the formation of material

of higher mol. wt. This mechanism results in an increase of asphaltene content and in a change of the colloid-chemical constitution and the rheological properties of the bitumen. A statistical study of these condensation reactions, in combination with chemical evidence, shows that besides ester groups direct carbon-to-carbon bonds are also formed. The ratio of the 2 types of condensation can be estimated, and is found to depend in a high degree on the blowing temp. The oxygen consumed in the blowing process can be split up into that used for condensation reactions (25–60%) and that used in side reactions (40–75%). It is shown that at a blowing temp of *ca* 250° C an optimum in bond formation is obtained. As a practical illustration, the oxygen requirements of 2 different blowing fluxes are analysed. It is found that in a Middle East residue higher degrees of condensation are necessary than in a Venezuelan residue before the condensation products contribute to the disperse phase of the colloidal system.

(Authors' abstract.)

1389. Unconfined compression test of bituminous mixtures. H. F. Waller. *Bull. Amer. Soc. Test. Mat.*, 1956, (212), 56–7.—Tentative results are presented of an investigation of the effect on stability values of variations in forming pressure, rate of loading, and test temp of specific bituminous mixtures using ASTM Unconfined Compression Test (D.1074).

J. G. H.

1390. Influence of exposure conditions on the accelerated durability testing of asphalt. L. R. Kleinschmidt and S. H. Greenfield. *Bull. Amer. Soc. Test. Mat.*, 1956, (213), 69–73.—The historical background of accelerated durability testing of asphalt is briefly reviewed, and the necessity of establishing effective exposure conditions is emphasized. Weatherometer equipment and the procedure used with a variety of exposure conditions are described in some detail, and from the results so obtained it appeared that a cycle in which the specimens were exposed to 9 minutes of continuous cold water spray each hour for a 21-hr period proved most effective in the consistent differentiation of asphalts. J. G. H.

SPECIAL HYDROCARBON PRODUCTS

1391. Methane and its combustion. Melchett Lecture for 1956. A. Egerton. *J. Inst. Fuel*, 1957, **30** (192), 3.—Aspects considered include: limits of inflammability; combustion of methane; methane as a fuel; direct synthesis of methane; and production of methane by the hydrogenation reaction. 23 literature refs. D. K.

DERIVED CHEMICAL PRODUCTS

1392. Preparation of detergents by sulphonating Edeleanu extracts. M. Krajcinovic, B. Prohaska, and J. Jovanovic. *Nafta (Yugoslavia)*, 1957, **8** (2), 33–7.—In this paper the chemical treatment of Edeleanu extracts is studied. The dist (138°–300° C) of Edeleanu extract, as a by-product of solvent raffination of mineral oil, is used as raw material. In a series of experiments the optimal conditions of sulphonation with oleum and concentrated sulphuric acid are established in order to prepare the wetting agent.

(Authors' abstract.)

COAL, SHALE, AND PEAT

1393. Technological developments in retorting Colorado oil shale, 1944–54. B. Guthrie. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 415–36.—The tremendous reserve of oil contained in the oil shale deposits of Colorado prompted the Congress of the U.S.A. to initiate a research programme to determine the feasibility and methods of mining and retorting oil shale and converting shale oil into usable products. This work has been in progress for 10 years by the Bureau of Mines at the Oil Shale Mine and Engineering Experiment Station near Rifle, Colorado, and the Petroleum and Oil Shale Experiment Station, Laramie, Wyoming. At Rifle, a number of pilot-plant retorts were built and tested, including the NTU, Royster, gas-flow, dual-flow, countercurrent, and gas-combustion processes. The gas-combustion method, a continuous, single-vessel, countercurrent, gravity, gravity-flow retort, proved to have many advantages over other processes investigated. It is unique in the method by which the shale oil vapours are condensed into a fine stable mist within the retort and the products are cooled before they are withdrawn from the retorting vessel, thus eliminating the need for costly cooling water. A sufficiently large-scale pilot plant was constructed and operated with minimum development difficulties. The results from the first year of operation of this new plant have been encouraging, and there is every indication that the process meets all the basic requirements for a low-cost efficient retort. (Author's abstract.)

1394. Pilot plant experiments on combustion of Israel oil shale. E. Basevi, E. L. Clark, O. Schachter, and E. Gottesman. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 457–64.—A short introduction on Israel oil shale is given. An apparatus used for pilot plant combustion is described, giving results of tests in terms of utilization of available thermal energy matter, temp of the bed, and temp and composition of flue gases. The influence of air and feed rates has been assessed. The extent of carbonate decomposition in the mineral matter is discussed, depending on the variables as above.

(Authors' abstract.)

1395. Hydrogenation of Spanish bituminous shale oil. Study of lubricant fraction. R. Sanchez and J. R. Jurado. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 445–56.—A bituminous shale-oil of Puertollano, Spain, has been hydrogenated at low temperature (T.T.H.) in a pilot plant. The process was carried out at 6 different temp within the 375°–400° C range. The yield of the different products obtained by hydrogenated samples fractionated and refined in the lab has been established. This paper, however, deals only with lub oils. The total lubricant yield is 20–22% of the crude oil in the range of temp considered most suitable, which is estimated to range from 388° to 392° C. (Authors' abstract.)

1396. The shale oil industry in Sweden. C. Gejrot and E. Schjanberg. *Proc. Fourth World Petrol. Congr.*, 1955, **3**, 437–43.—The Swedish shale oil plant at Kvarntorp, which was built during the war, has since been largely reconstructed, extended, and modernized. It is now in a position to cover its costs in full, including normal depreciations, and to render a return on the invested capital. Manufacturing costs must, however, be further reduced and its products more widely utilized and refined. Thus the surplus of pyrolysis gas is to be converted into ammonia, gasoline is to be refined catalytically, and the ash used as building material. The problems of the purification of flue gases and the gasification of shale coke are being considered in order to open the way for a further expansion of the plant. (Authors' abstract.)

MISCELLANEOUS PRODUCTS

1397. Fluids for the grinding of titanium. E. J. Krabacher. *Lubric. Engng*, 1955, **11** (6), 397–401.—Special difficulties encountered in the grinding of titanium are enumerated, and fundamental factors affecting the machining of titanium are presented as bases for the formulation of an effective grinding fluid. From this data a screening test based on glass wetting properties of potential fluids has been evolved which indicates the suitability of a high additive EP-fluid as the most effective type of grinding medium. J. G. H.

CORROSION

1398. Adapting the Static Water Drop Test to research methods. E. J. Schwoegler and L. U. Berman. *Lubric. Engng*, 1955, **11** (6), 381–8.—The Static Water Drop Test, used effectively by Federal authorities in the evaluation of corrosion inhibitors, suffers from the disadvantage of a lengthy test period—168 hr. Details are presented of modifications in the preparation of test pieces which enable the test to be used with a 48-hr test period in the evaluation of polar organic cpds as corrosion inhibitors. J. G. H.

1399. Zinc coatings make steel last longer. E. P. Helms. *Oil Gas J.*, 8.4.57, **55** (14), 106.—Advantage of zinc for coating steel by modern inexpensive methods includes benefits of galvanic action of the inorganic zinc coatings and availability of the coatings as base or primer for organic coatings. Methods of application and costs are discussed. G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT

1400. Some current trends in the design of fuel injection equipment for diesel road vehicles. J. S. Skinner. *Gas Oil Pwr*, 1957, **52**, 47–50.—Describes, with many illustrations, the operation of several types of fuel injection systems. H. C. E.

MISCELLANEOUS

1401. World supplies of oil. Anon. *Gas Oil Pwr*, 1957, **52**, 42.—Summary of a discussion of the Diesel Engine Users Association, Jan 1957.

Whilst the consumption of motor spirit has fallen to 28% from 49% in 1938, the proportion of middle dist has increased from 17 to 27%. Percentages for individual countries depend upon the availability of coal. It is predicted that, whilst the total consumption will continue to rise, the proportion of motor spirit will fall farther.

The monetary saving of diesel as compared with petrol vehicles is due mainly to fuel taxation. The tax part of total saving is $\frac{3}{5}$ for the U.K., where petrol and diesel fuels bear the same tax, and is greater for countries where the diesel fuel has the lower tax.

The economic advantage of the diesel engine is being reduced: (1) by increasing efficiency of high C.R. petrol engines; (2) by rising costs of diesel fuel due to limited supplies. If all road transport used petrol engines, as in N. America, the percentages of motor spirit and middle dist would alter by *ca* 10%, and the present refinery unbalance would be rectified. If taxation is ignored, the diesel is the most economical for continuous operation of stationary sets, or in a large (*e.g.* locomotive) vehicle. At present the lower operating costs of the road diesel engine are due to economy on tax. Meanwhile, to ensure sufficient supplies of diesel fuel, specifications should be as wide as possible. H. C. E.

1402. U.K. consumption in 1956. Anon. *Petrol. Times*, 26.4.57, **61** (1558), 367.—A summary is given of the Petroleum Industry Advisory Committee document "U.K. Petroleum Industry Statistics Relating to Consumption and Refinery Production 1955 and 1956," comprising an analysis of U.K. inland oil deliveries into consumption. G. A. C.

1403. Hydrocarbon oil duties in 1955–6. Anon. *Petrol. Times*, 26.4.57, **61** (1558), 368.—Statistics are given from the 47th Report of the Commissioners of H.M. Customs & Excise for year ending 31 March 1956 and show a rise in revenue from £305·5 million to £323 million. G. A. C.

1404. Better management. Functions of leadership. Anon. *Oil Gas J.*, 15.4.57, **55** (15), 112.—Functions of leadership, performance requirements, and correct approach are discussed in a series on better management. G. A. C.

1405. Australian symposium. Various. *J. Inst. Fuel*, 1956, **29** (190), 478–503.—Various papers presented at a symposium on "Fuel and Power—Vital Elements in the Development of Australia" organized by the Australian members of the Inst of Fuel, held at the University of Sydney on 22–23 May 1956. The papers give an account of Australian fuel problems and their solutions. The papers included are: Energy Supply and Usage in Australia, by W. H. Spooner; Coal in the Future, by S. McKensey; The Fuel and Energy Requirements of the Steel Industry, by W. H. Brook; The Future Development of the Gas Industry in Australia, by C. C. Challis; Developments in the Petroleum Industry in Australia, by J. D. Rogers; The Place of Atomic Power in the Australian Fuel Position, by J. P. Baxter; The Electric Power Systems of Australia, by V. J. F. Brain; The Availability and Training of Engineers in Relation to the Future Development of Fuel and Power, by L. G. Hunter; The Changing Pattern in the Use of Fuels as it Emerges from the Papers Presented. A summing up, by F. W. G. White. D. K.

1406. Issues of international oil policy: the Middle East. W. J. Levy. *Petrol. Times*, 12.4.57, **61** (1557), 313.—The limitations of international agreements are discussed, together with implementation of international oil policy. G. A. C.

1407. Problems of fuel production and utilization in New Zealand. J. I. Graham. *J. Inst. Fuel*, 1956, **29** (190), 504.—A brief review of the fuel and power resources of New Zealand is given, together with a comparison of energy production from coal with that from hydro-electric power and imported oil. The paper is concerned in the main with coal, its mining and utilization. D. K.

1408. Purchasing for the oil industry. E. N. Hague. *Petrol. Times*, 12.4.57, **61** (1557), 328.—The oil industry point of view is given regarding the purchase of equipment for the industry. G. A. C.

1409. School science in relation to industry. Anon. *Petrol. Times*, 12.4.57, **61** (1557), 337.—A description is given of the Shell Short Course for Science Teachers. G. A. C.

1410. The Iranian oil operating companies. Anon. *Petrol. Times*, 12.4.57, **61** (1557), 323.—Salient features are given of activities in 1956 in Iran, including drilling, production, pipeline loading facilities, refining, Abadan refinery equipment, staff and labour, housing, training and education, recreation, medical services, and general financial information. G. A. C.

1411. Remarks on measuring electrolytic resistances. (In German.) E. Blum. *Erdöl u. Kohle*, 1956, **9**, 386.—On applying low frequency a.c. to electrolytic resistances polarization occurs. Up to 1000 Hertz units this is negligible. This range is satisfactory for drilling mud and mud filtrates but not for filter cakes. The behaviour of elec resistances is discussed. Measured resistance results for drilling mud, mud filtrates, filter cakes, salt waters, and well cores are comparable only when the same method is used, or the sources of error described are avoided. R. T.

1412. Mineral oil industry, its present position in the world and future prospects. J. W. Platt. *Erdöl u. Kohle*, 1956, **9**, 350–6.—*Cf.* Abs. **602**, 1957. R. T.

1413. Science and technique in Soviet Union—development of the Soviet petroleum industry within the framework of the sixth 5-year plan. L. Tomaszewski. *Nafta (Krakow)*, 1956, **12**, 108–9.—The sixth 5-year plan from 1955 to 1960 will see such expansion of the petroleum industry as is required to provide other industries with the right fuels and lubricants. Total industrial production will rise by 65% compared with 1955, or over threefold compared with 1950. It is to approach the total reached by the U.S.A. and exceed that of Britain, France, and Germany together. It is planned in particular to increase the production of crude by 91% and of natural gas by 400%. Thus the crude will reach the figure of 135 million tons (nearly 4·5 times as much as in 1940). Further drilling in search for oil will amount to an extra 95%, whilst costs should fall by 30%. Light dist will increase by 200% and lubricants by 180%. Refining capacity will rise by 43 million tons and cracking by 26 million tons. New natural gas fields are expected to provide 85–90% more gas, and new pipelines will reach 9000 km. Chemicals from petroleum will increase in tonnage and, in particular, rubber and alcohol by 220% and 900% respectively. M. S.

1414. Packaging for the oil industry. W. A. Carter. *Petrol. Times*, 26.4.57, **61** (1558), 376.—Methods of packaging to accepted standards, materials, preservation, identification, cleaning and drying, protectives, waterproof packaging, use of desiccants, and cushioning are reviewed. G. A. C.

1415. Determination of sulphur compounds in polluted atmospheres. A. Fusaroli and A. Foschi. *Riv. Combust.*, 1957, **11** (3), 167–77.—Methods are considered and discussed to determine SO_2 as a pollution agent of the atmosphere, as produced by combustion in homes and industries and from exhaust of motor vehicles. The multiplicity of research on the present atm pollution conditions in Italy must be based on systematic methods both sufficiently simple and not exceedingly expensive. Filtration methods are therefore suggested such as titration in absorption tubes (Cauer tubes), where the air to be analysed is bubbled through, such methods being considered the most suitable to determine an average representation of the atm pollution. The proposed method is therefore oriented towards the periodic determination systems which have been in use for some time in England. This does not, however, exclude that in particular cases the American method may be also employed to supplement the average representative data, using automatic recorder equipment for instantaneous indication of pollution. (Authors' summary.)

1416. Research into pollution of city atmospheres by motor vehicles. M. Giubileo. *Riv. Combust.*, 1957, **11** (3), 157–66.—The amount of pollution in a city atmosphere due to engine exhausts of motor vehicles was the object of an investigation in Milan. The contaminants considered are CO (contained in exhaust gases in amounts of 0·1 up to 8·4%) and cpds derived from TEL, which are liberated in the solid form. The exhaust fumes were analysed under the electron microscope, and in samples originating from leaded fuels the presence of microcrystalline particles, with a dia of 10–400 mμ, was observed.

It was found that CO in atm air had a max concn of 80–100 p.p.m. in central streets, 80 p.p.m. in tunnels. In the suburbs CO was not measurable. Lead was measured in the air of streets (2·4–7·4 g/cu. m. of air) and in dust on the ground, both in the streets (0·44–2·36 mg/g of dust) and in garages (0·23–5·22 mg/g). The carbon monoxide and lead concn found were in connexion with the local amount of traffic.

It is believed that pollution from motor vehicles in Milan is comparable with that existing in other cities, while present concn of CO and Pb in atm air are considered harmless.

(Author's summary.)

1417. The cost in Britain of air pollution from different types of source. R. S. Scorer. *J. Inst. Fuel*, 1957, **30** (194), 110.—The factors which determine how damaging air pollution will be are discussed for the various classes of fuel consumer. Estimates are made for the cost of air pollution from the different sources per ton of fuel consumed. 7½ pages of discussion. D. K.

1418. Oil industry pushes profits higher. Anon. *Chem. & Eng. News*, 4.3.57, 98.—Oil industry profits were higher during 1956, in part due to increasing revenues, and in general the included figures appear favourable. The outlook is for still another good year in 1957. W. H.

1419. More dollars for petroleum research. Anon. *Chem & Eng. News*, 22.4.57, 67.—Due to the greater income to the Petroleum Research Fund, more grants for fundamental research and advanced scientific education in the petroleum field have been authorized. W. H.

1420. Pemex plans large programme. Anon. *Chem. & Eng. News*, 18.2.57, 58.—According to recently released statistics of Petroleos Mexicanos (Pemex), the industry has produced 340 million brl of crude during the period 1952–56. A large construction programme, now under way, which is estimated to cost Pemex $94 million to complete, includes the installations of long-distance oil and gas lines, construction of 2 25,000-b.d. cat cracking plants, together with new electric power and steam plants, completion of a 300-million-cu. ft/day gas absorption plant, completion of dry docks at Vera Cruz, and further refinery modernization.

The vast petroleum reserves, figures for which are given for Dec 1956, can be expected to push consumption of this fuel in both domestic and export markets. W. H.

1421. Ethyl has new way to T.E.L. Anon. *Chem. & Eng. News*, 22.4.57, 76.—This method is totally different from any ever used or proposed to make TEL, and involves reactions between non-halide lead cpds and metal organics, such as triethylaluminium, di-ethyl zinc, or ethyl sodium. This new process is a mild one which is carried out between room temp and 100° C and at atm pressure. The use of appropriate solvents appears also to be very important where yields are concerned. Many examples are quoted and the requirements for further research stressed. W. H.

1422. Consolidation in Yugoslavia. Anon. *Petrol. Press Serv.*, 1957, **24** (4), 137–40.—Readjusted industrial organization—fostering light industries, agriculture, and transport, especially motor transport, with a switch of existing plants to consumer goods is improving the position of the Yugoslav population. Events in the U.S.S.R. and neighbouring states have caused an alteration in the economic structure. A weak point in the economy is the persistent payments deficit. Yugoslavia has eased her chronic shortage of capital and foreign exchange by foreign economic loans (see *Petrol. Press Serv.*, Nov 1955, p. 395). Wheat—previously exported—cotton and fats are obtained from the U.S.A. on a long-term

policy. Coal and electricity production have risen. Yugoslavia's needs of petroleum products >800,000 metric tons/year. Crude oil production has risen by *ca* 40,000 tons/year in each of the last 4 years to *ca* 300,000 tons in 1956. It is expected to rise to *ca* 400,000 tons/year in 1957, due to recent discoveries in Croatia and Banat province. Natural gas production is rising; piped to Belgrade, it will supplement town gas supplies and provide feedstock for a fertilizer plant. Oil seepages and gas shows occur in the Drava area, and the coastlands near Sinj in Dalmatia contain bituminous shales. Oil and gas production has involved a capital outlay of £57·3 million. In the period 1946–56 net profits from oil production totalled Dr. 10,500 million, and are expected to reach Dr. 27,000 million in the following 10 years. (1 Dr. = 840 : £). It is hoped that all past investment will be recovered by *ca* 1975. Oil demand is a good index of Yugoslavia's economic progress. Inland consumption of all petroleum products has risen from 630,000 metric tons in 1953 to 690,000 tons in 1954, 750,000 tons in 1955, and probably >800,000 tons in 1956. The 1955 total included 195,000 tons gasoline, 160,000 tons gas–diesel oils, and 22,000 tons fuel oil. Most inland needs are supplied from local refineries. R. T.

BOOK REVIEWS

Kuwait and her Neighbours. H. R. P. Dickson. London: George Allen and Unwin, 1956. Pp. 637. 75*s*.

The author of this book became closely connected with Arabia and Arabian politics when transferred from the Army to the Middle East Political Department in August 1915. Working under the direction of Sir Percy Cox, who was engaged in replacing Turkish rule by a new civil administration in Mesopotamia, he had exceptional opportunities of acquainting himself with Arab customs and establishing friendships with Sheikhs who carried weight with the unruly tribesmen of the delta provinces. His profound knowledge of the language enabled him to converse freely with those he was expected to coax into submission to a central authority. His related experiences and adventures with turbulent and rebellious tribesmen indicate a man of unusual courage and determination that marked him out for other political duties in Arabia. After the termination of the first world war he was appointed Political Agent in Bahrain, and in 1920 he returned to Iraq for service. In 1927 Dickson became Secretary to the Political Resident of Persian Gulf Affairs at Bushire, and in 1929 he was transferred to Kuwait as Political Agent, and played an important part in events which eventually determined the supremacy of Ibn Saud and led to the peaceful settlement of the Kuwait frontiers. His official association with Kuwait ceased with his retirement in 1936, but from that time he continued in Kuwait as chief local representative (Arab relations) of the Kuwait Oil Company.

Although essentially a realistic account of Arabian affairs that led to the subjugation of Saudi Arabia by Ibn Saud, this volume gives the background of the circumstances that led up to the conquest and consolidation of truculent tribes who resisted western infiltration and methods, and the granting of oil concessions to an American group. From the context will be gleaned the part Britain played in assisting Ibn Saud when he was engaged in suppressing a succession of tribal revolts. A fascinating story is unfolded of the intrigues, quarrels, and violence that resulted in the ultimate supremacy of Ibn Saud over much of Arabia. The subjugation of rebelling tribes entailed much desperate fighting and brutality which Britain watched with grave misgivings, due to the wavering policy in her Arabian allegiances. Three chapters in Part I are devoted to a description of Eastern Arabia, with its historical background, sparse resources, and the medley of nomadic tribes ruled by powerful Sheikhs who determined their attitude with little regard to the proclamations of a suzerian power.

Part II, in 10 chapters, gives an account of historical events between 1742 and 1930, when Britain, with an interest in Persian Gulf affairs, made protective treaties with rulers quite unable to resist invasion by other powers. In Chapter VI–XII the story is told how, in the guise of a Protector of Islam, Ibn Saud succeeded in welding Wahabism into a religious force that secured for him the powerful support of the priestal element. As supreme dictator he enforced on the populace implicit compliance with Islamic principles that had long fallen into neglect, such as daily prayers at prescribed hours, and under severe penalties prohibited the use of tobacco, hashish, opium, and alcohol. He also forbade such vices as gambling, black magic, and other evil practices.

The impositions created many enemies, but he was hopeful, with the aid of the Imams, of securing the position of Sherif of Mecca. In the early part of the war Britain was heavily subsidizing Hussain, Sherif of Mecca, who in 1916 broke off allegiance to Turkey and proclaimed himself King of the Hejaz, installing his son Abdullah as Sherif of Mecca. Although the situation was reluctantly accepted by the British Government, serious trouble was foreseen, as it upset many plans concerning Arabia's future. Ibn Saud and Hussain continued their endeavours to arrive at some agreement for some time, but this was clearly impossible, although the British Government was doing everything in their power to avert a conflict. Meanwhile Britain had succeeded in getting Kuwait to break with Turkey and assist in the conquest of the Basra region. All attempts to patch up a peace failed, and in 1919 a force headed by Abdullah was decisively beaten by Ibn Saud and forced the expulsion of both Hussain and Abdullah from Arabia. The King fled to Cyprus and Abdullah to Turkey.

The author was dispatched on a mission to Ibn Saud in 1929 to ascertain his intentions and initiate friendly relations if possible, and his account of those efforts in Chapter X seems to show that Ibn Saud was no fanatic and saw the manifold advantages of some arrangement with Britain that secured aid in the protection of his insecure frontiers and the pacification of revolting tribes, who on provocation ran into British-controlled territory. As an example of his real character it is related how he sent to the author's tent at night a packet of choice Egyptian cigarettes with the injunction to smoke only in secrecy. The author also relates how Ibn Saud arranged for a British subsidy of $75,000 to be shared by some Christian-controlled charity. Ibn Saud also clearly saw the advantage of turning roving nomadic tribes into town dwellers, whereby he could better control their activities.

Envious eyes were always fixed on the clean, flourishing port of Kuwait, and raids became so frequent and exasperating that the British declared in 1920 that unless they ceased, punitive measures would be taken by the R.A.F. in Iraq.

The author's marriage and return to Iraq with his wife in January 1921 was followed by efforts to settle with Ibn Saud the frontier of Iraq, where tribal raids and counter-raids caused the authorities much concern. Whilst engaged in this task he was joined by Major Frank Holmes and Dr Mann of the Eastern General Syndicate, who had been invited by Ibn Saud to go into the interior and report on the alleged occurrence of oil and the prospects. Although the

object of his journey was described by Holmes as a search for a very rare butterfly, the British authorities were well aware of the true purpose; indeed, the author had himself endeavoured to locate an oil seepage near the Qatif Oasis recorded in Turkish days and known to him when political officer in Bahrain. The author had also examined Jebel Dhahrain after reading Turkish reports of an oil seepage.

An amusing description of Holmes, who had established a friendship with Ibn Saud, is given. He appeared at Dickson's house dressed as the proverbial tourist at the Pyramids of Egypt carrying a white green-lined umbrella and wearing a French military-type helmet from which hung a green gauze veil. He is described as an amusing, interesting companion, oozing charm and mirth, but suffering from bladder trouble. When describing his objective as the capture of a very rare butterfly, the author's wife surprised him by maliciously retorting that it was the first time she had heard an oil seepage called a butterfly. Holmes had something like 50 cases, boxes, bags, and guns, most of which were presents from Ibn Saud.

The author was able to give Holmes useful hints about travel in country he knew so well, yet he still insisted on a certain route, maintaining that only in the Qatif Oasis was the Black Admiral of Qatif to be found. The author's immediate task was to induce Ibn Saud to attend a conference with leading Sheikhs and important personalities to settle frontiers, and this was arranged for 21 November 1922, at Uqair. At this place had assembled an imposing array of notabilities from Kuwait, Iraq, and Saudi Arabia, with their attendants housed in white tents some distance from the Fort. With Ibn Saud was Major Holmes, who had met him at Hufuf. At this conference Sir Percy Cox sat as a kind of umpire, and five days of hard bargaining followed, during which generous hospitality was lavished by Ibn Saud. Only on the sixth day, when there seemed no prospect of a settlement, did Cox intervene and state just where the frontier should be fixed. After a display of intense irritation and annoyance Ibn Saud agreed to his decision and proclaimed Cox as a dear friend and counsellor. Although regarded as grossly unfair to Kuwait, it settled finally a line which has never since been seriously disputed, and ensured reasonable peace.

Not until the last day did Ibn Saud ask Percy Cox whether the British Government would raise any objection to the grant of an oil concession to Holmes and his London associates. Ibn Saud affirmed that Holmes had reported favourably. Cox replied "No," but reminded him that the Eastern General Syndicate was not an oil company and that they would probably trade off the concession to others. Later followed a talk between Cox and Holmes, when a map was produced showing the large extent of the concession under review for oil exploration.

Although far from happy about Holmes' claim and the back door method of his approach, Cox was unwilling to antagonize Ibn Saud after settlement of the boundary dispute and remarked that he felt sure the British Government would help him in every way to develop the resources of the country. Dickson eventually ascertained that the seepage he sought had at the time been enveloped and hidden by one of the travelling sand dunes that are a feature of this desert country. At both Qatif and Dhahrain, oil pools of great value were later discovered.

Chapter XVII covers the period of the second world war and describes some of the German machinations in Kuwait and Iraq designed to destroy British interests. The author was asked in 1941 to take over the duties of Political Agent in Kuwait, where normal conditions returned after the failure of a rebellion and the arrival of forces at Basra. World war II caused a virtual suspension of oilfield operations for some years in Arabia, and the succeeding chapters are mainly devoted to descriptions of desert travel and meetings with important Sheikhs. Chapter XX, dated 1946, describes the ceremonies connected with the first shipment of oil from Kuwait and the popular celebrations that attended the occasion. Few of those present perhaps realized then the immense oil potentialities of this tiny state of 6000 square miles.

In this chapter the expressed views of a number of those closely associated in one way or another with Middle East oil affairs are given, from which can be adduced the factors that have led to serious disagreements between various Arab States, and between them and the Western countries. Hostility to Israel is the one point upon which all Arabs are agreed, and it forces one to admit that the departure of Britain from Palestine was a major misfortune and the direct cause of most troubles with Arabs. Having secured for the Arabs their independence and their gratitude, our support for Israel has converted the Arabs into enemies. The author again refers to his previous conviction that having once consolidated his position Ibn Saud would proceed to discard his Wahabi doctrines and set about introducing Western methods and ways of life. The death of Ibn Saud in 1953 was unfortunate, for it left less-experienced sons to handle the increasing discontent arising from neglect of religious observances and the influence of Western ways.

The impact of the West is not the only adverse influence at work in Arabia, for the influx of disgruntled Egyptians, Lebanese, Syrians, Yemenis, and others has resulted in much anti-Western propaganda, encouraged and financed by a power desirous of breaking British and American preeminence in the Gulf zone. Nationalization is another popular line of attack from the younger, educated class, who give no thought of the riches brought to their countries through oil by the wise expenditure of vast sums on prospecting and developing an industry. The fact that an infiltration of Western manners and conduct is endangering the Islamic religion is another factor that arouses the discontent of the older Arabs, who resent relaxation of their precepts.

The book is well illustrated and concludes with a glossary of Arab terms and 6 maps. It can be regarded as a valuable and reliable account of the turbulent tribes that inhabit Eastern Saudi Arabia and Kuwait. A. B. T.

Instrument Technology. Vol. II. Analysis. E. B. Jones. London: Butterworths Scientific Publications, 1956. Pp. xi + 208. 40*s*.

This book is one of a series of three dealing with instrument technology, and has been written for the instrument maintenance engineer with the object of providing him with the "why" as well as the "how" of instrument maintenance. It is clearly written and well illustrated, and the information has been presented in a logical manner. The importance of good sampling is emphasized, the first chapter dealing entirely with sampling systems for both gases and liquids. The subdivision of the book has been made according to the physical principles involved, and these are presented at the beginning of each chapter or sub-section.

In a book of this size it must be appreciated that it is impossible to cover the whole field of instrumental analysis, and the author has therefore confined his attention to the more common types of measurement, the subjects dealt with being specific gravity, humidity, chemical composition (including spectroscopy, electrochemical methods, chemical absorption, thermal conductivity, para-magnetism), and measurement of viscosity. It is surprising, however, that under chemical composition no mention has been made of polarography, coulometry, or gas chromatography, a technique which, apart from its already established broad

scope in the laboratory, has great potentialities in the field of continuous plant stream analysis.

It is felt that in dealing with spectrochemical analysis it would have been well to refer to the increasing use of emission spectroscopy outside the non-metallurgical industries, *e.g.* the petroleum industry. On the subject of infra-red spectrometry, it is regrettable that the instrument described is the now obsolete manually-operated instrument and not the automatic recording double beam spectrometer with its high degree of instrumentation. It is also considered that the chapter on viscosity could, with advantage, be expanded, or, alternatively, suggestions made for additional reading. In fact, the value of the book as a whole could be increased by well-selected references for more detailed reading on all the subjects covered.

However, there is no doubt that the practising instrument engineer will find this book of considerable value. It could also provide the chemist or physicist with a useful introduction to the field of instrumental analysis. H. P.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

000 STANDARD OIL COMPANY OF CALIFORNIA. Oil: finding, refining, research, transporting, marketing. San Francisco, Calif., Standard Oil Co., n.d. 49 p.

020 ASSOCIATION FRANÇAISE DES TECHNICIENS DU PÉTROLE. Annuaire 1957. Paris, AFTP, 1957. 193 p.

*020 WORLD PETROLEUM CONGRESS. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings. Section 3. Oil processing. Rome, Carlo Colombo, (1956). 582 p.

*020 WORLD PETROLEUM CONGRESS. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings. Section 4. Petrochemicals products. Rome, Carlo Colombo, (1956). 360 p.

080 BRITISH PETROLEUM CO. LTD. Annual report and accounts for the year ended 31st December 1956. London, BP, 1957. 40 p.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1423. More from your dip-log surveys. C. Franks and B. White. *Oil Gas J.*, 8.4.57, **55** (14), 102.—A new method of interpreting continuous dip logs has proved very successful in interpreting structural conditions in salt dome fields and low-relief structures. The method is described, and it involves the routine determination of dip so that it is possible to locate as closely as possible positions of faults, unconformities, or any other breaks in the subsurface section. It is important that the data represent formation dips, and not apparent dips from sedimentary features, and for this purpose the dip-log curves should be correlated over at least 10 ft of hole.

A method of classifying the dip data and the plotting of the results is given, with examples. 5 refs. C. A. F.

1424. Modernized core drilling for structure. R. W. Biggart. *World Oil*, 1957, **144** (5), 134.—Core drilling techniques in the Mid-Continent area of the U.S.A. are described. The method consists of logging shallow core holes (electric log or γ-ray log) to determine near-surface structures which are used to predict deep structures. A small mobile drilling unit is used which can drill 3–8-inch dia holes down to 1400 ft. Logging units are lightweight and mounted on trailers.

A map shows the area of the Mid-Continent which is favourable for economical and efficient core drilling. This is in the central area N. and SW. of the Arbuckle and Wichita Mountains, where there are competent Lower Permian and Upper Pennsylvanian markers. C. A. F.

1425. Limestone reservoirs. W. J. Burgess. *Oil Gas J.*, 15.4.57, **55** (15), 198.—Porosity in limestones may be primary or secondary, primary porosity being acquired at deposition, and secondary porosity by post-depositional leaching and replacement, which is often only local in origin. There may be several cycles through which the limestone changes from a porous to a non-porous state, depending on changing conditions in the circulating waters.

Carbonate reservoir traps can be classified into 6 types; anticline, unconformity, onlap, fault, porosity, and reef, and the characteristics of each of these are discussed briefly, the reef trap being emphasized. In this type of trap it is important to study the types of environment for reef formation, which are on the seaward edge of a shallow, clear-water shelf, or on the fringe areas between a platform and a basin. C. A. F.

1426. What's ahead for the Permian basin? W. D. Thorn. *Petrol. Engr*, 1956, **28** (13), B21–7.—Proof that the heyday of this area is yet to come lies in the provision of new crude pipelines to the Gulf Coast. Further points considered are: (1) stratigraphic trap-type fields yet to be found; (2) value of secondary recovery not yet at its peak; (3) the increasing value of W. Texas sour crudes. E. A. G. H.

1427. Texas test hits. Anon. *Oil Gas J.*, 8.4.57, **55** (14), 82.—1 Alamosa Ranch, 14 miles N. of Vega, Texas, in the Palo Duro basin, has recovered 4000 ft of 40° oil on a test of Pennsylvanian limestone at *ca* 6100 ft. Nearest production is at the Rehm field in the Dalhart basin *ca* 40 miles N.

The Palo Duro basin has been little tested; it contains Permian and pre-Permian rocks, and is flanked by buried anticlinal structures. C. A. F.

1428. South Eastern New Mexico's rich oil and gas potential. R. F. Montgomery. *Petrol. Engr.*, 1956, **28** (13), B33–7.—A brief history of oil discovery in this area and some major structural features are recounted. Its general geology is described, with graphical illustration of the main oil sources at present. Most oil is now coming from rocks of Permian age, but accelerated drilling and geophysical activity indicates the increasing importance of Devonian, Silurian, and Ordovician formations. E. A. G. H.

1429. South Florida oil prospects are good. H. T. Brundage. *World Oil*, 1957, **144** (5), 140.—There are good oil prospects in Florida, especially in the S. part of the state and in neighbouring offshore areas. Subsurface information is limited, but it is thought that the Cretaceous and lower Tertiary limestones should be productive along trend lines approx parallel to and S. of the S. flank of the Ocala Uplift, which is a regional feature in the central part of the peninsula.

The first field in Florida was found in 1943 at Sunniland and the second, Forty Mile Bend, in 1954. Both produce from the Cretaceous Sunniland limestone from below 11,000 ft and are situated near the S. end of the peninsula. C. A. F.

1430. "Trend players" look to Western Kansas Cherokee. E. D. Goebel and D. F. Merriam. *Oil Gas J.*, 1.4.57, **55** (13), 127.—The Cherokee formation in W. Kansas has excellent prospects as a major reservoir rock following the discovery of 7 new fields and 2 new zones in 1956. Recently discovered Cherokee fields in the area occur along a NW.–SE. trend along the W. side of the Central Kansas Uplift. Traps are variable and include small anticlines and stratigraphical traps. Most of the reservoirs are sandstones.

The development and geology of 14 Cherokee fields are briefly outlined, and electric log cross-sections and stratum contour maps are included for the Patterson, Hardtner, Davenport, Shiley East, and Webs area fields. 5 refs. C. A. F.

1431. Tristate basin has 20 pay zones. K. G. Boling. *Oil Gas J.*, 1.4.57, **55** (13), 146.—The Tristate or Illinois basin contains a potential producing area approx 250 miles by 150 miles in Indiana, Illinois, and Kentucky. 20 pays have been found in the basin at depths above 6000 ft, and a variety of traps occur. Seismic surveys have been successful, and there has recently been increased core drilling activity. There is much subsurface data available for the area, where some 75,000–80,000 wells have been drilled. The geology of the basin is outlined; many of the fields are anticlines, but stratigraphic traps are now the main targets, with Chester sandstone pays which have produced over $\frac{1}{2}$ of the total oil production of the area. C. A. F.

1432. Santa Cruz basin holds important promise. E. A. Gribi. *Oil Gas J.*, 1.4.57, **55** (13), 113.—The Santa Cruz basin of the central coastal area of California has produced small amounts of oil for many years, but recent exploration indicates that the basin has important potential as an oil province. The geology of the area is outlined. The beds range from Pliocene to Eocene, which rests on undifferentiated Mesozoic "basement," and the geological history is complex with intense movements in the Pleistocene and Recent. Surface oil seeps are abundant. Exploration will be costly, as the area is mountainous, and because of the complexity of structure and stratigraphy, and large private land tracts.

The basin is 75 miles long with a sedimentary column totalling 25,000 ft. C. A. F.

1433. Cuba's north coast offers good exploration prospects. H. Wassal. *World Oil*, 1957, **144** (5), 240.—3 wells recently drilled in central Cuba have indicated the presence of a salt dome. The stratigraphy of each test is given, and on the assumption that the feature is a dome, the structural history of the area is interpreted. The wells were drilled in the vicinity

of the Cunaga hill, a surface feature composed of Miocene beds strongly folded into an anticline trending NE. to SW. Gravity surveys showed a gravity minimum coincident with the hill, and salt has been penetrated in 2 of the wells at depth. A pre-Tertiary evaporite section is also known on the N.-Central coast.

It is suggested that the Cunaga hill is underlain by a piercement salt dome involving the penetration of volcanic and other rocks, and overlain by folded Miocene beds.

Other untested gravity minima occur in neighbouring areas of N. Cuba. C. A. F.

1434. Nicaragua hunt goes offshore. Anon. *Oil Gas J.*, 8.4.57, **55** (14), 85.—A well is being drilled 25 miles offshore from the Nicaraguan coast in the Caribbean Sea. It is planned to drill to 13,500 ft. There is a concession of 11 million acres in the area where previously 2 shallow onshore dry holes were drilled. C. A. F.

1435. Peru strike looks good. Anon. *Oil Gas J.*, 8.4.57, **55** (14), 86.—Maquia 1, 3 miles E. of the Ucayali river near Contanama, on test flowed 605 b.d. from 2150 ft from the Sugar sandstone, which outcrops near the Agua Caliente field, *ca* 100 miles to the S. This is the first Peruvian discovery E. of the Andes since Ganso Azul was found in 1938.

The area is remote, and although only major production would justify a pipeline across the Andes, small production has a market eastwards, where oil from Agua Caliente is being shipped to Manaos in Brazil. C. A. F.

1436. The oil geology of the Middle East. J. C. M. Taylor. *Petroleum, Lond.*, 1957, **20** (4), 129–34.—The main oil deposits in this region are outlined and stated to contain ⅔ of the world's proved reserves. A brief geological history of the area is then given, revealing the many favourable factors inherent. The difference in constitution of the 2 main types of oil, namely, that occurring close to the mountain front of Turkey, Iraq, and Iran and that present in S. Iraq, Kuwait, and Arabia, is discussed. Then further reference is made to the history and exploration of separate oilfields within the 2 groups. E. A. G. H.

1437. Iranian field extended. Anon. *Oil Gas J.*, 15.4.57, **55** (15), 99.—Agha Jari 30, a deep test 6 miles NW. of the known limits of the Agha Jari field in Persia, topped the Asmari limestone at *ca* 6400 ft and has a potential production of 20,000 b.d. The field has over 40,000 proven acres of production, and in 1956 averaged 371,500 b.d. from 22 wells.

Gach Saran, the southernmost field, is under development, and at the end of 1956 was producing 40,000 b.d. C. A. F.

1438. Africa success highlighted by blocking of Suez Canal. Anon. *World Oil*, 1957, **144** (5), 235.—Recent oil discoveries in N. and W. Africa are outlined. In Algeria the most promising find is at Hassi Messaoud, *ca* 60 miles SE. of Ouargla in the Grand Erg Oriental, where a well drilled following a refraction survey has found *ca* 450 ft of Trias oil sand with varying reported estimates of potential up to 6280 b.d. The Trias has also been found productive at Talemzane, 175 miles NW. of this discovery. 2 oilfields have been found in the SE. Sahara Desert in the Fort Flatters area, at Edjele near the Libyan border, and at Tiguentourine, 40 miles W. of Edjele. Promising gas discoveries are also reported *ca* 300 miles SW. of Fort Flatters.

In coastal W. Africa gas dist has been found at Logbaba and at Souellaba in the Cameroons, and in Senegal encouraging oil and gas shows have been found in several wells. In Nigeria oil and gas has been found at Afam, 20 miles E. of Port Harcourt, and at Oloibiri, on the Niger Delta, several wells have found oil at moderate depths.

In French Equatorial Africa oilfields have been discovered in the coastal salt dome areas at Point Clairette and at Ozouri in several Eocene and Cretaceous pays.

In Angola a field has been found at Luanda following the discovery in 1955 of the nearby Benefica field near the Atlantic coast. C. A. F.

1439. Brahmaputra wells prove successful producers. Anon. *World Oil*, 1957, **144** (5), 247.—23 successful producers have been completed in the Nahorkatiya and Hugrijan oilfields of the Upper Brahmaputra Valley during the last 2 years. A new find is reported at Moran, 25 miles W. of Nahorkatiya, where a well has been drilled to 13,379 ft. C. A. F.

1440. Contribution to the study of the ostracods of the Lower Eocene (s.l.) of the Paris basin. V. Apostolescu. *Rev. Inst. franç. Pétrole*, 1956, **11** (11), 1327–52.—The samples studied came from classic beds of the Montian, marine Thanetian, brackish Sparnacian, and marine Ypresian (Cuisian). A study of a brackish horizon in the Lutetian was also included. The sites of the localities are listed.

Marine forms found in the Thanetian include *Cytherella*, *Brachycythere*, *Trigintiglymus*, and *Cytheretta*; in less saline water there was *Clithrocytheridea*. These ostracods were very fragile.

In the brackish Sparnacian there were many individuals but few species. The genera included *Clithrocytheridea*, *Vetustocytheridea*, and *Neocyprideis*. Except for *Trigintiglymus comendiensis* and *Paracypris trosliensis*, the marine Cuisian yielded the same forms as the marine Lutetian, zones II–IV. The ostracods are of facies as well as stratigraphic significance. A table shows the time distribution of those fossils.

Descriptions of new species and genera are appended. G. D. H.

1441. Critical studies of the marine ostracods of the Lower and Middle Cretaceous of the Champagne Humide and the Bas Boulonnais. G. Deroo. *Rev. Inst. franç. Pétrole*, 1956, **11** (12), 1499–535.—Ostracod collections from the Cretaceous o Haute-Marne, and those of Cornuel and Stchepinsky were examined. The sites from which the specimens were obtained are listed, and there are systematic descriptions of the species, as well as photographs and tables showing the stratigraphic distribution of the various forms. The species described belong to the genera *Cyntherella*, *Paracypris*, *Bairdoppilata*, *Apatocythere*, *Clithrocytheridea*, *Dolocytheridea*, *Schuleridea*, *Brachycythere*, *Protocythere*, *Cytheropteron*, *Eocytheropteron*, *Orthonotacythere*, *Cythereis*, *Isocythereis*, and *Platycythereis*. G. D. H.

1442. Studies of certain zones of the bituminous Kimmeridgian in Eastern France. Y. Gubler and M. Louis. *Rev. Inst. franç. Pétrole*, 1956, **11** (12), 1536–43.—For more than a century Upper Jurassic bituminous rocks have been exploited between Bellegarde and Belley, the oil being used first for lighting, but now insecticides and other products are recovered. The bituminous limestones are of Kimmeridgian age, in a N.–S. basin 45 km long and 22 km wide. On the edges of the basin the beds are rarely thicker than 4–5 m; in the centre they can attain 60 m. To the E. and S. are reefs; to the W. and NW. are deposits derived from reefs. The lagoonal zone has remains of higher plants, and there are pores and pollens. Peridinians and hystrichospheres occur and have been considered to be the source of the bituminous matter. The rock shows banding which is linked with the organic content.

Chloroform removed 4·3% of the rock material, and this had a high acid value, and 16·67% sulphur. Treatment of the limestone with HCl liberated an additional organic extract of 4·3–6%. These extracts were mainly resinous and pseudo-asphaltenes. Insoluble organic matter is present, and may be the parent substance of the soluble matter, which it is suggested is a proto-petroleum rather than an asphalt. Some

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posal wells have shown a variety of materials to be present, which can cause pore plugging and permeability reduction around the well bore. Many of these deposits can be removed by inhibited HCl containing surface-active agents and possibly HF, but some of the dissolved products may be precipitated if the acid becomes completely spent. Tests have shown that precipitation of aluminium and ferric hydroxide can be prevented by using stabilized acid. Comparative evaluation of acid treatments should be made between wells with similar injection water. C. A. F.

1464. New injection method affords total oil recovery. N. J. Clark, W. P. Schultz, and H. M. Shearin. *Petrol. Engr*, 1956, **28** (11), B45–7.—By controlling the composition of injected gas within a critical range, capillary forces in a reservoir are reduced to zero, thereby releasing all the oil in the pore spaces to the critical mixture. The idea is reputed to be workable in all types of drives, irrespective of stage of recovery. This new process of gas displacement is compared with waterflooding and then described in detail. E. A. G. H.

1465. Production of viscous crude oils. (In German.) N. Schwarz. *Erdöl u Kohle*, 1956, **9** (8), 511–15.—The average yield of crude oil from a deposit is 30%, in exceptional cases it is 75%. World reserves of visc oils—excluding tar—are estimated at 5 milliard m³, only *ca* 12% or 0·6 milliard m³ is producible. On account of bad yields *ca* 6% of the total residual oil is not producible. The bad yield of visc oils in water displacement is caused by the "finger effect"—illustrated by a lab example and discussed—which is greatly dependent on the visc relation. Methods for increasing the yield are discussed. Increasing the visc of the displacing phase is scarcely possible with gas. With water or aq soln no substance of economical val is known. Thinning the oil with a solvent and heating the pool are practicable. Kerosine may be used, followed by water displacement. When using materials other than kerosine, *e.g.* propane or butane, water displacement may be replaced by gas circulation. The influence of raising the pool temp is considered. The bottom of the hole is heated by burning gas or oil, electrically, or by hot liq or vapour circulation in the borehole. Germany—where pools of viscous crude exist, and the price of crude oil is higher than abroad—is ideal for this relatively expensive process to be exploited economically. 16 refs. R. T.

1466. New auto-pneumatic lease programming system. D. M. Taylor. *Petrol. Engr*, 1956, **28** (13), B28–32.—An all-pneumatic system of instrumentation automatically operates 12-well separator stations without electricity in W. Texas, making possible a reduction in tank batteries from 141 to 10. The working of the pneumatic system is explained and its purpose described. Finally, the modes of operation of the well testing programmer and pneumatic integrator are discussed. E. A. G. H.

1467. Peak pumping efficiency? C. J. Merryman and B. L. Franks. *Petrol. Engr*, 1956, **28** (13), B93–121.—Dwindling production in Texas area was halted as dynamometer and other instruments aided planned lease studies to cut lifting costs. Details of the recording instruments are described and dynamometer analyses for 2 wells discussed. Further sections deal with the utility of the dynamometer in lease surveys, and workovers and completions. E. A. G. H.

1468. Fresh water fracturing in the Permian basin. S. J. Martinez and R. E. Hurst. *Petrol. Engr*, 1956, **28** (13), B63–83.—Over 100 wells have been treated with fresh water rather than viscous liq, with a payout and profit on 80%. The new technique increases permeability by dissolving salt from reservoir rock. The size of treatments, effect of high injection rates, the effect on formation, and salt removal are discussed. Tabulated results of fresh water treatments are given. E. A. G. H.

1469. Newest aid to multi-stage fracturing. J. E. Kastrop. *Petrol. Engr*, 1956, **28** (13), B40–7.—Multi-stage fracturing is being accelerated in the Permian basin of W. Texas by injecting $\frac{7}{8}$ inch dia rubber balls at the surface into the fracturing stream between each fracture stage. Their purpose is to seal off casing perforations opposite the more permeable zones, permitting controlled fracturing of the less permeable horizons. Sections dealing with stage and multi-stage fracturing, the idea and requirements of ball sealers, and the effect of fluid visc and velocity are presented. Radioactive tracer surveys and pressure records of the fracturing treatment are discussed with illustrations. E. A. G. H.

1470. Design considerations for gas-fired field processing equipment. E. C. Young. *Petrol. Engr*, 1956, **28** (12), B122–36.—The utility of gas-fired equipment was realized when inadequate handling facilities for natural gas existed. Optimum field performance must be assured in the use of gas-consuming heaters, treaters, and reboilers, while required heat loads, type of heating units, and safety factors must be considered in selecting equipment. E. A. G. H.

1471. Design considerations for small unattended field gas compressors. M. L. Hipple. *Petrol. Engr*, 1956, **28** (12), B110–20.—The author concludes that reliable basic operating data, location of field station site, and future expansion must be considered to develop plans and specifications for station equipment; further, each application must be decided on the individual merits of the proposed operations. E. A. G. H.

1472. Liner failures harass Ventura operators. D. H. Stormont. *Oil Gas J.*, 8.4.57, **55** (14), 96.—With deeper drilling in the Ventura field, California, there has been an increase in the number of drilling and completion problems, in particular mechanical deformation of liners; sand production which clogs or cuts out liners; and the deposition of asphaltenes in borehole, liner, tubing, and surface equipment. The main problems are opposite the deep D.7 and D.8 zones, and the cost of remedial work on wells which have failed due to one or more causes is *ca* $6 million p.a. Further deep development of the field is limited by these conditions. *Ca* 60% of D.8 wells have failed at least once since their completion in 1953 or after.

Suggested causes for these conditions are given, mechanical failures being thought to be due to the highly stressed conditions of the beds at depth. Remedial efforts involve using heavy-walled, high-strength liners; the elimination of liners in the producing zones by using open-hole gravel packs; and providing stress-relief joints in the liners.

Ventura Avenue is a multi-reservoir field, and the accumulations are partly controlled by an anticline and by a series of thrust faults within it. Some zones have been repeated up to 4 times by thrusting. The total producing section is *ca* 6000 ft, of which *ca* $\frac{1}{4}$ to $\frac{1}{2}$ is net effective pay. The zones are arbitrarily divided into 8, and consist of alternating sands and siltstones. C. A. F.

1473. Mud slug cuts liner cost. J. J. Fowler. *World Oil*, 1957, **144** (5), 169.—The use of a slug of heavy drilling mud in the drill pipe whilst setting a liner is briefly described. The method, which has been used successfully in the Tabasco field, Hidalgo County, Texas, involves placing the liner plug, and, when the drill pipe is ready to pull, a heavy mud (17·5 lb/gal) is introduced which displaces the excess cement upwards, leaving the top of the liner clean. The displacement of the cement above the top of the liner does not affect the splice. It is claimed that the method can give a saving of $6000/well. C. A. F.

1474. Subterranean waters of the Gösting–Domung. (In German.) K. Friedl. *Erdöl u. Kohle*, 1956, **9** (8), 505–11.—The most important salts in these waters are NaCl and $NaHCO_3$, constituting 80% min—in some cases 98%—of the evaporation residue. $CaCO_3$, $MgCO_3$, and $(NH_4)_2CO_3$ are present in soln. Sulphates of all kinds are present in small quantities. This and the high I cont characterize these waters as true oil waters, *i.e.* their salt cont derives exactly as the hydrocarbon org substance. In judging a water its concn, *i.e.* its evaporation residue, and salinity are important. Presence of salts, and max and min found in waters from various horizons are discussed. Chemistry and concn of the salts in the individual water-bearing horizons differ, so that, from these factors, the origin of the water can be decided. Especially Cl_2 estimation—whose quantity reflects both salinity and evaporation residue—suffices in most cases for characterization and determination of the origin of a water. The differences shown by the waters of individual horizons make it possible to specify—with great certainty—the origin of a doubtful water. Herein lies the great val of the water analysis for drilling and production technique. R. T.

1475. Custom-designed well stimulation. R. W. Coburn. *Oil Gas J.*, 4.3.57, **55** (9), 102.—Field tests in Oklahoma, Kansas, and W. Texas have established a procedure in which oil containing 2 lb/gal of sand can be pumped through a standard jet hole ($\frac{3}{8}$ inch o.d.) at approx max rate of 1·3 brl/min/perforation. Additional tests have shown that lease crude (40°) can be pumped through the same perforation at *ca* 1·5 brl/min/perforation. Ball sealers were used during the fracturing treatments, and their application is described. C. A. F.

1476. Evaluating D.S.T. data. Pt 1. A. J. Zak and P. Griffin. *Oil Gas J.*, 15.4.57, **55** (15), 122.—A drill stem test provides qualitative and quantitative data of the fluid contents of the tested interval, with the pressure history of the test. An example of a typical test report is given, and the use of pressure build-up data is discussed, the Horner and Hurst–van Everdingen methods of analysis being given. 5 refs. C. A. F.

1477. Saturation and porosity from electric logs in shaly sands. Pt 1. A. J. de Witte. *Oil Gas J.*, 4.3.57, **55** (9), 89.—Resistivity relationships between clean sands and shaly sands are discussed, and it is shown that plots of parabolas representing the relationship between rock conductivity and water saturation for sands varying from clear to shaly are very close to curves of the type $y = x^n$. 12 refs. C. A. F.

1478. Analysis of pressure build-up curves. (In German.) E. Blum. *Erdöl u. Kohle*, 1956, **9**, 436–41.—The laws governing pressure build-up—a transient, compressible flow within the entry zone—are presented. Their application for analysis of pressure build-up curves is described. Analysis amounts to finding the linear section of the reconstructed pressure build-up curve in plotting p against log $\frac{t}{T+t}$ or log t. This linear section is independent of the decreasing after-production of the well shortly after shutting-in, and of conditions at the outer boundary of the entry zone. The inclination of this straight line bears a close relation to the effective permeability K of the reservoir rock far from the bore. The relation of permeability Kp_1 calc from the productivity index to this effective permeability K permits recognition of an eventual permeability change in immediate proximity to the bore, and estimation of the productivity change thus produced. The linear section then gives the pressure p_0 at the beginning of production of the well—by extrapolation to $\frac{t}{T+t} = 1$—only if the well exists in an infinitely extended deposit. This is important, since each well, for some weeks after taking into production, may be considered to exist in an infinitely extended deposit. 15 refs. R. T.

1479. Formation evaluation by log interpretation. Pt 1. Interpretation of well logs in clean water wet rocks of intergranular type. S. J. Pirson. *World Oil*, 1957, **144** (5), 159.—The use of well logs for quantitative estimations in respect of clean water wet intergranular rocks is described. Effective pay can be estimated from SP logs and micrologging devices. Porosity is best determined from devices having a short radius of investigation, such as the micro-neutron log, but several different devices can be used, and indirect methods are available. Water saturation can be obtained by a variety of methods, the oldest of which makes use of Archie's formula. Permeability can be estimated by petrophysical correlations, and an empirical formula is available which relates water saturation, porosity, and permeability.

Examples of log interpretation are given, together with a series of charts which can be used for practical problems of interpretation. C. A. F.

1480. Waste heat treats oil at isolated lease. P. Hardu. *Petrol. Engr*, 1956, **28** (13), B56–66.—With 2765 b.d. of fluid to treat from one well, and little gas available, Felmont Oil Corpn utilizes waste heat to accelerate water–oil separation. Operating costs are included. E. A. G. H.

1481. Possibilities and methods of electric and radioactive diagraphy. M. Martin. *Rev. Inst. franç. Pétrole*, 1956, **11** (12), 1544–70.—In quantitative interpretation of resistivity logs the essential factors are R_{mf}, R_w, R_{xo}, and R_t. These are defined, and the principles involved in determining them are set out. The radial distribution of the fluids in a permeable formation is discussed, and the effects of the residual oil saturation in the flushed zone on the interpretation of the logs is indicated.

The S.P. log values are dominated by the electrochemical potentials. The static S.P. is defined, and a chart relating the ratio of the observed S.P. and static S.P. with various parameters is given. Methods of determining the value of R_w are given for high-salinity formation waters, for fresh formation waters with relatively large amounts of salts other than NaCl, and waters for muds with appreciable amounts of gypsum or $CaCl_2$ in soln.

Charts show the resistivity of the soln and activity of Na for different concn of Na and various cpds; other charts show similar data for some calcium and magnesium cpds. The relationship between the equivalent resistivity and the resistivity is shown for a considerable number of oilfield waters and for $CaCl_2$ and $MgCl_2$. There are also curves for the same type of data at bottom-hole temp ranging from 75° to 400° F. G. D. H.

1482. New techniques paying off at Loudon. Anon. *Oil Gas J.*, 15.4.57, **55** (15), 88.—The Loudon field in S. Central Illinois has been flooded for the past 7 years, during which the production history has shown it to be very successful. Multi-zone injection has been followed, and wells have been drilled on the sunflower pattern. 3 pays can be flooded simultaneously from one injection well, and the spacing pattern involves drilling the output wells on diagonal spots to form an octagonal layout with 8 output wells around a central injection well.

Further expansion of the project is planned. At present 12,800 acres are under flood, and average output is 32,000 b.d. C. A. F.

OILFIELD DEVELOPMENT

1483. Statistics play vital role in exploration. F. H. Lahee. *World Oil*, 1957, **144** (5), 129.—Analysis of new-field wildcats drilled in the U.S.A. from 1944 to 1955 inclusive shows that,

of the 58,031 wells of this classification, 6927 (or 11·94%) were completed as producers. When drilled on technical evidence the wildcats were successful nearly 3 times as frequently as those sited on non-technical considerations. Major companies were 15·23% successful, compared with only 9·75% success for minor companies and independents.

C. A. F.

1484. 100 fields found, 58 producing oil. N. Williams. *Oil Gas J.*, 1.4.57, **55** (13), 142.—Over 100 fields have been discovered on the continental shelf offshore from Louisiana. 58 of these are oilfields, and the others gas or gas-condensate. Offshore production in 1956 was over 40 million brl oil, and gas production (with many fields shut in) has reached more than 440,000 M.c.f/day.

Geological conditions on the shelf are similar to those on the bordering land areas within the prolific Miocene trend. It is expected that ultimate development will be comparable with the onshore area. C. A. F.

1485. Oil and gas reserves reach new highs in both U.S.A. and Canada during 1956. Anon. *World Oil*, 1957, **144** (5), 103.—Reserves of liq hydrocarbons in the U.S.A. in 1956 increased by 886 million brl to a new peak of 36·3 billion brl. Natural gas reserves increased by 14·1 trillion cu. ft. to a peak of 237·8 trillion.

In Canada reserves of crude oil and natural gas liq increased by 372·7 million brl to a new peak of 3·1 billion. 6 tables are included; they show: (1) estimated proved U.S. reserves of liq hydrocarbons, by years to 1956; (2) summary of changes in 1956 in proved U.S. reserves of liq hydrocarbons; (3) estimated proved reserves of liq hydrocarbons in the U.S.A. and Canada, by areas; (4) summary of changes in 1956 in proved U.S. reserves of natural gas; (5) estimated proved reserves of natural gas in the U.S.A., by years to 1956; and (6) estimated proved recoverable reserves of natural gas in the U.S.A., by states. C. A. F.

1486. Canadian reserve figures reach new heights in 1956. Anon. *World Oil*, 1957, **144** (5), 247.—During 1956, Canada's reserves of crude oil and natural gas liq increased by approx 373 million brl to a peak of over 3·1 billion brl. *Ca* 544 million brl were found and 172 million brl produced.

Reserves at the end of 1956 were estimated at 3,129,304,000 brl. A table shows estimated proved reserves of liq hydrocarbons in Canada, as at Dec 1955, Dec 1956, reserve additions during 1956, and changes during 1956, by states. C. A. F.

1487. Saudi Arab offshore field to go on production soon. H. T. Brundage. *World Oil*, 1957, **144** (5), 238.—The Safaniya field on the W. side of the Persian Gulf was discovered in 1951, and has since proved to be the largest known marine offshore field. Production comes from 2 Cretaceous formations, the Zubair and Bahrein zones, at 5000–5600 ft. *Ca* 70,000 surface acres appear to be productive, and development wells to date have extended the field to over 10 miles from the shore.

A new 142-mile, 22-inch pipeline will be completed shortly, and this will link the field with the refinery and terminal at Ras Tanura. Initial capacity will be 50,000 b.d., increasing to 125,000 b.d. Additional gas turbine pumping facilities are planned, and these will permit a max rate of 190,000 b.d. Most of the line is buried, but in the salt flat areas the pipe is carried *ca* 2 ft above ground.

Offshore wells and emplacements are to have cathodic protection, as the Gulf waters are highly corrosive.

C. A. F.

1488. French push big Sahara development. Anon. *Oil Gas J.*, 15.4.57, **55** (15), 100.—Plans for development of the oilfields and transport facilities in Algeria are outlined. They include the construction of 2 10-inch pipelines from Hassi Messaoud and Edjele to the railhead at Touggourt, with eventually a 20-inch line direct from the fields to the Mediterranean coast. Work is in progress on a railway to meet the small dia lines.

Intensive development is planned, and it is hoped that the fields will be producing at least 95,000 b.d. by the end of 1958. C. A. F.

1489. Search for petroleum and natural gas in the Rhineland Palatinate. (In German.) W. Kolb. *Erdöl u. Kohle*, 1956, **9**, 433–6.—Prospecting—with progressively improved methods—is discussed under 4 periods: 1896–1914, 1926–31, 1936–39, and post-1950, including 1955. In 1926 the extent of exploration in the Rhein–Hesse Palatine region up to the start of industrial production resulted—apart from the extensive geological and geophysical val of the work—in 32 exploration wells—metrage 3401 and 51 semi-wildcat wells—metrage 52,655. In 60 years search 4 from a total of 51 wildcat wells have become oil or natural gas producers. Production of natural gas from Eich gas field is guaranteed for a number of years. Outside the Rhine valley trough a wildcat at Meisenheim, located in the Permian, should prove the presence of petroleum in the Palæozoic. R. T.

TRANSPORT AND STORAGE

1490. Properties of steel for tank construction. F. J. Feely, Jr., and M. S. Northup. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 81–100.—This paper covers progress to date on brittle-fracture studies being conducted in the Standard Oil Development Co's Esso Engineering Department lab. These studies were undertaken following the failure of 2 large oil storage tanks in England in the spring of 1952. The object was to determine what can be done to insure against similar tank failures in the future. From the beginning of the lab programme emphasis was placed on development of a test to simulate conditions at the time of a tank failure. The paper outlines the steps taken to develop this test. A comparison is made which shows the close agreement between test results, using steel from the 2 tanks which failed in England, and the calculated stress at the time of failure. Information is included showing the brittle behaviour of conventional semi-killed and rimmed tank steels as compared with fully-killed steels made to fine-grain practice. Also, the paper outlines efforts to obtain a correlation between the test results and the fundamental physical properties of the materials tested. Finally, a section is included discussing the possible future application of the test results to the design of tanks which are "safe" from brittle fractures. Future work planned to make possible the practical application of this knowledge is also outlined. (Authors' abstract.)

1491. New techniques for the reduction of evaporation losses. A. Champagnat. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 31–48.—The comparatively recent development of high quality films from pure polyvinyl chloride, together with new fabricating techniques, have made possible the construction of simple devices for reducing breathing and filling losses in storage tanks. These devices can be adapted to any existing tank without structural alterations and provide advantages which could not be obtained with metallic materials. The introduction into the tank is made through a normal manhole, and installation can be carried out in a few hours. Evaporation losses are reduced either by means of a smaller liq surface or by a smaller vapour vol. The improvement, relative to conventional tankage, is at least a 70% reduction of total evapora-

tion loss, and may reach 100% with one of the devices mentioned. The new method considerably diminishes tank fire hazards, and the initial investment is paid out over a period ranging from a few weeks to a few months.

(Author's abstract.)

1492. The problem of brittle fracture. W. Soete, H. Herbiet, and R. Doucet. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 179–96.—Present specifications of steel for oil storage tank construction offer no particular guarantee against the danger of brittle fracture. The spectacular accidents which have occurred to tanks have proved that they should be dealt with as in shipbuilding and metal structures. After reviewing the construction problem of storage tanks, and listing the precautions to be taken in building them, the article stresses the importance and feasibility of making the quality of the steel used appropriate to the brittle-fracture stress to be withstood. Some examples are given to show that the different steels available do actually offer some types of good brittle fracture resistance. Experimental results are given proving that this property is bound up with metallurgical factors, and in both Thomas and Martin steels suitable qualities can be found for the purpose in question. (Authors' abstract.)

1493. Storage of oil fuel with particular reference to the heated grades. T. Chippindale. *J. Instn Heat. Vent. Engrs*, 1957, **25**, 1–17.—There is a general trend towards the use of heavier grades of oil fuel. Delivery methods are described and recommendations made regarding the capacity of users' storage installations. Spec of oil-fuel grades are given, and the significance of visc, fl. pt., and pour-point in relation to storage problems is discussed. Storage and handling temp are examined and recommendations made. Filling lines, suction lines, and ring mains are described and a formula given for friction losses in oil pipelines. Details of the construction of steel, concrete, and glass-lined concrete tanks are given, and the location of storage tanks and the construction of tank chambers are discussed. There are no statutory regulations regarding oil fuel storage, but safety precautions are discussed, and the recommendations of BS 799 : 1953, Oil-burning Equipment, and of the Fire Offices' Committee and the L.C.C. "Code of Practice" are described and commented upon. It is concluded that the precautions are adequate and the standard of safety high. R. T.

1494. Bonded-wire strain gauges for determining secondary stresses in pipelines. 2. D. L. Shipp, G. M. McClure, and H. J. Grover. *Petrol. Engr*, 1956, **28** (13), D25–32.—In this part the electrical strain-measuring circuit of such gauges is described, together with the sources of circuit instability. A brief method of analysing the results is indicated.

E. A. G. H.

1495. Pipeline into Persia. Anon. *Inst. Petrol. Rev.*, 1957, **11** (125), 139.—A brief account is given of the recently completed central portion of the Abadan–Teheran 10-inch welded line, with the 4 pumping stations. G. A. C.

1496. Construction of natural gas pipelines in Diepholz-Osnabrück region. (In German.) R. Tachilzik. *Erdöl u. Kohle*, 1956, **9**, 460–3.—The natural gas pipeline—electrically welded—to deliver 500,000 m³ at N.T.P., of dry gas from Rehden gas field to places of consumption is described. Corrosion protection specified consists of external bituminizing with impregnated glass-felt wrapping—double when required—and liming. Details are given—with supporting illustrations—of the difficulties encountered. All operations were to spec and rigorously controlled by official inspection. R. T.

1497. Subsurface gas storage. R. Delsol. *Rev. Inst. franç, Pétrole*, 1956, **11** (11), 1391–405.—The first successful subsurface gas storage was at Buffalo, W. of New York, in 1916. In 1930 there were 3 such reservoirs, in 1947 70 (aggregating $7{\cdot}8 \times 10^9$ m³); in 5 years from 1949 the figure rose from 80 to 184, with an aggregate of 63×10^9 m³. At Engelbostel, near Hanover, and at Beynes, near Versailles, coke-oven gas is being similarly stored. 80% of the U.S. gas storage is in Pennsylvania, Virginia, Michigan, Kansas, and Oklahoma, areas where there was much natural gas production early this century. These reservoirs are fed from Texas and Louisiana. These storage projects have benefited from knowledge obtained in connexion with repressuring and secondary recovery. Storage costs for natural gas range from 2840 F/m³ for spheres (5 kg/cm²) to 7–15 F/m³ for aquifers and 2·5–6·25 F/m³ for exhausted oil or gas fields. One of the largest underground reservoirs stores $2{\cdot}8 \times 10^9$ cu. m. (Jeannette, Pennsylvania). Even in the U.S.A. attention has had to be turned to aquifers. The Herscher dome, 90 km from Chicago, was of this type, and for a time had losses, principally from badly cemented old wells.

Subsurface storage of coke-oven gas raises problems with regard to possible chemical reactions because of the large rock surface exposed, and the presence of various cpds in soln, as well as pyrites, lignite, and iron salts, in addition to bacteria.

When gas storage near Paris was suggested the Beynes and Bray anticlines were possibilities, the former being nearer. The first well at Beynes showed 2 aquifers, one in Albo-Aptian sands at 275 m and the other in Wealden sands at 400 m. The first supplies water around Paris. The second has a cover of 7 m of black plastic clay. A dozen deep wells supported shallow data, revealed no fault, and indicated a storage capacity of 320×10^6 m³ at 38 kg/cm². Soundness of the cover was shown by different water pressures above and below. Each gas well is expected to give $5–10 \times 10^3$ m³/hr. Test injection showed that water was easily displaced.

In 1954 Paris gas consumption in winter was *ca* 2·5 times that in summer. In 1961–62 potential winter consumption may exceed production, and so subsurface storage would help. Connexion to a ring pipeline is possible. It was hoped to inject $12–15 \times 10^7$ m³ of coke-oven gas in May–Sept 1957.

The Bray structure has a Lusitanian sand at 218–236 m, 100 m of closure, and a capacity exceeding 1×10^9 m³ at 22 kg/cm². This might store refinery gas or even imported gas. G. D. H.

1498. Revolution at sea. F. O. Braynard. *API Quart.*, Winter 1956–57, 13–19.—A review of evolution in propulsion, size, and speed of oil-carrying vessels in view of necessity, and the impact of 2 world wars and the Korean war. The 1956 world total of ocean-going tankers was 44,530,000 tons, in Sept 1939 it was 16,912,000 tons. The average speed rose from 11·1 to 14 knots, and the average deadweight capacity increased by 45%. R. T.

1499. Modern mechanical handling equipment. R. T. Hartmann and R. J. L. Fish. *Petroleum, Lond.*, 1957, **20** (5), 173–5.—In modern oilfield and refinery operations versatile machines of great robustness and utility are required. Straddle carriers, fork-lift trucks, mobile cranes, and self-operating carriers are the points of interest in this paper.

E. A. G. H.

1500. Mechanical handling techniques. J. M. Beskine. *Petroleum, Lond.*, 1957, **20** (5), 165–70.—Initially, the author briefly reviews the justification for and techniques of mechanical handling in the petroleum industry. Then applications are discussed with special emphasis on methods for use with finished products. He gives details of systems used at the Barton installation of Shell-Mex and B.P. Ltd. and suggests that in developing new systems attention be given to methods which have proved advantageous in other industries. In addition, the linking of continuous with batch handling is described with examples. E. A. G. H.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1501. Refinery engineering in Italy. S. Brizzi *et al.* *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 19–29.—This report briefly covers the Engineering Department's problems and activities at the Naples refinery of the Socony-Vacuum Italiana, S.p.A., as an example of the post-war development and organization of the engineering work in the Italian refineries. With this aim, a general discussion on the subject is followed by a more detailed description of the jobs performed by 5 typical refinery engineering departments, *i.e.* process, planning, corrosion, maintenance, and safety engineering. (Authors' abstract.)

1502. Painting of steel structures in petroleum refineries. J. O. Jackson and J. Bigos. *Proc. Amer. Petrol. Inst.*, 1956, **56** (III), 34–48.—Petroleum refineries can save large sums of money each year through the proper painting of steel. Petroleum hydrocarbons themselves are uncorrosive, but the production, storage, and refining facilities are attacked by condensate, sour crude, and sweet oil contaminants. There are 2 general types of corrosion: direct chemical oxidation and electrochemical. Coatings, which may be metallic, organic, or inorganic, constitute the most widely used method of preventing corrosion. When steel costs upwards of 15 cents/lb, in place, painting appears more economical than adding a corrosion allowance to the steel. The most important factors in gaining good service from paint systems are proper design and surface preparation, and correct application, selection, and formulation of paints.

Structural steel in a refinery can be grouped into 4 categories: storage tanks, process units, yard piping, and buildings. Painting the roof and shell of volatile-product storage tanks white is recommended when product savings compensate for shortened paint life. The paint protection necessary for process units is determined by severity of environment. Painting of yard piping is not always economically justifiable, and consideration should be given to the cost of the protecting system, safety markings and colour identification. Building interiors, usually non-corrosive, are easily protected and colour conditioned at no extra cost to give good appearance and light reflectivity. (Authors' abstract.)

1503. Temporary rust preventives—a review of formulations. E. S. Lower and S. Cressey. *Petroleum, Lond.*, 1957, **20** (4), 143–7.—Lanolin and certain of its constituent alcohols and acids are the bases of most temporary rust preventives. The protective life of various oily films, solvent-deposited soft films, and hard film solvent-deposited types is then mentioned. Finally, comparative experiments are described, with practical advice on precautions to be taken during manufacture, storage, and use of rust preventives. E. A. G. H.

1504. The effect of graphitization of steel on stress-rupture properties. J. C. Wilson. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 78–86.—On 10 May 1955, at the 20th Midyear Meeting of the API Division of Refining, a summary report entitled "Graphitization of Steel in Petroleum Refining Equipment" was presented. This report covered the examination of 554 samples of carbon and carbon–molybdenum steel removed from petroleum refining equipment. It included the information that, in as much as some of the samples showed decreased ductility as measured by the bend test, additional work would be undertaken to determine if graphitization adversely affected the stress-rupture properties of carbon steel. The report covers this work. (Author's abstract.)

1505. An industry viewpoint of the use and value of API Standard RP-500. F. C. Somers. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 90–5.—Since its establishment in 1955 by the API Sub-Committee on Electrical Equipment, the API Standard RP-500: Recommended Practice for Classification of Areas for Electrical Installations in Petroleum Refineries, has been regarded by the majority of the refining industry as a sound basis for classifying areas. Problems encountered in the use of RP-500 are: the tendency to use explosion-proof equipment where it is not needed; application of principles to locations not specifically covered, such as the lab; and inconsistent treatment of electrical and non-electrical sources of ignition. In general, the experience with RP-500 has proved its value and fundamental soundness. Further progress toward better refinery electrical installations requires the development of economical and reliable equipment designed specifically for Division 2 locations. As experience in preparing RP-500 demonstrated, the petroleum industry must provide the initiative for the solution of the equipment problem. (Author's abstract.)

1506. Some notes on seals for rotating shafts. E. F. Boon, S. Honingh, and D. C. van Rijssen. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 1–18.—The shaft seal is an essential item of petroleum equipment, the fundamentals of which are little understood and have been little studied. This paper gives some of the results of recent investigations by the chemical equipment group of the Institute of Technology, Delft, Netherlands. It is shown that a packing, if carefully mounted after recompression, without breaking the packing ring, can have a performance that approaches the theoretical optimum, *i.e.* packing pressure will equal fluid pressure. Some ideas on the design of mechanical seals are advanced. The distortion of the sealing ring due to forces and temp gradient is considered. The visco seal, which is now being developed, depends on the pumping action of a sealing fluid in a groove winding around the pump shaft. The results obtained so far are promising for sealing rotating shafts against HP gas at room temp. The calculated diffusional leakage is of the order of 10^{-6} g/hr, far lower than is possible with mechanical seals or packing boxes. (Authors' abstract.)

1507. Graphite formation in petroleum-refining equipment. A. M. Hall. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 213–26.—The fundamentals of graphite formation in steel are discussed so far as they are presently known. The process is the result of the decomposition of the iron carbide in steel, and takes place by a nucleation and growth mechanism. The investigation of graphitization in refinery equipment sponsored by the API at Battelle Memorial Institute is described. Though graphite was frequently found, the number of cases in which its presence might impair the use of the equipment was not large. No case of a failure due to graphitization was observed. Of the steels studied, only those containing chromium showed immunity to graphitization. The extent to which graphite formation impairs the mechanical properties of steel is under investigation. This question has been studied by means of bend tests and room-temp tensile tests. A programme to determine the effect of graphitization on stress-rupture properties is now in progress.

Summary of new material. The new material in the paper comprises room-temp tensile tests of graphitized sections removed from refinery equipment, as well as preliminary stress-rupture tests of the same material. The results showed that when graphite concentrates to a sufficient extent at the low-temp edge of the weld-heat-affected zone, room-temp tensile strength and ductility can be adversely affected. Similarly,

the indications are that rupture life can be reduced by this type of graphitization. (Author's abstract.)

1508. Occlusion of hydrogen in steel. J. G. Wilson, W. A. Bonner, H. D. Burnham, and T. Skei. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 227–44.—Hydrogen occlusion in steel in oil refinery equipment containing liq water and hydrogen sulphide may often cause severe damage to the steel in the forms of blisters and fissures. Methods of predicting and detecting hydrogen penetration have been developed. When continued high hydrogen penetration is observed, frequent inspection of the equipment is recommended. When hydrogen penetration is slight or sporadic, damage to the steel is not usually encountered. Preventive measures against hydrogen damage to steel have included the following: (1) expendable metallic and ganister linings; (2) extensive water wash for the removal of hydrogen-penetration promoters; (3) the injection of corrosion inhibitors and polysulphide soln. Small quantities of polysulphide will reduce corrosion and minimize hydrogen penetration. The formation of polysulphide *in situ* can be achieved by the injection of oxygen or air into the gas stream while the pH of the water is maintained in excess of 7·8. The protection afforded by polysulphide is attributed to its ability to convert cyanide to thiocyanate, as well as to its ability to form a protective film on the surface of the steel. This paper describes the practical solutions to problems of hydrogen attack as well as those associated with air injection. (Authors' abstract.)

1509. Production of static electricity by movement of fluids within electrically grounded equipment. A. Klinkenberg. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 253–64.—Since flowing fluids may carry an electric charge, flow into an insulated container may charge such a container to a dangerous potential. In this respect, the precautionary measure of grounding a tank truck is well known. If, however, the walls of the equipment, from, through, and in which flow takes place are grounded or at least electrically connected, there may still be a potential danger of an explosion. This fact is related to the high insulating properties of many petroleum products. A discussion is presented of the various mechanisms that may give rise to a dangerous build-up of electric charges within equipment. This survey is illustrated by an analysis of some operations that should be considered dangerous. Discussion of mechanisms for the production of charges. It is pointed out that the charges may originate at any interface between a hydrocarbon oil and another material (air, water, acid, caustic soln, clay, metals) and are already present at such an interface in the absence of flow. Discussion of mechanisms for the generation of high potentials. Any relative movement of the materials mentioned above may separate opposite charges and thereby, if the separation takes place in an insulating fluid, give rise to the generation of high potentials. Application. The operations that have become known as dangerous are analysed as regards mechanism of generation and build-up of charges. Some precautionary measures are also discussed from this angle. (Author's abstract.)

1510. Protection of equipment in an oil refinery against electric discharges. F. d'Este. *Proc. Fourth World Petrol. Congr.*, **7**, 1955, 265–78.—One of the principal causes of fire in a petroleum refinery is static electricity. The way in which electrostatic charges could be produced on refinery structures and equipment is discussed, and a study is presented of the consequent electric potential fields. The protection systems are analysed, with particular regard to grounding. The formation of charges originating from the atmosphere and the potentials involved are dealt with by the author, and the protection systems, their efficiency, and construction characteristics are discussed. (Author's abstract.)

1511. The Ropes gasoline plant. F. H. Lacy, Jr., and G. B. Evans. *Proc. nat. Gas Ass. Amer.*, *35th ann. Conv.*, 1956, 15–20.—Ropes field, Hockley County, Texas, was discovered in 1950, and 16 wells were on production in 1953. Production —from the Canyon Reef formation at 9300 ft depth—is owned by the Honolulu Oil Corpn and Signal Oil and Gas Co. Consideration of relevant factors indicated that reservoir pressure would be maintained at or above bubble-pt pressure by water drive alone, or water drive + water injection. The vol of the relatively rich gas—<2000 M.c.f/day—makes it imperative to keep capital and operating costs at an abs min. Lack of transport facilities necessitates plant design to recover, fractionate, and load products utilizable in the truck transport market. To meet pipeline residue gas spec it is necessary to dehydrate the residue gas and to recover <65% of the propane in the wet gas together with practically all the heavier hydrocarbons. Processing techniques—as presented with a supporting flow diagram—are necessary for all-round economy. Shutdown and alarm points are listed and shown on the flow diagram. R. T.

1512. The Claytonville midget gasoline plant. W. W. Pyeatt. *Proc. nat. Gas Ass. Amer.*, *35th ann. Conv.*, 1956, 22–5.—Construction and operation of 3 "Midget Gasoline Plants" ranging from 2 to 5 MMFCSD capacity are described. The plants—of the compression-refrigeration type—are designed to produce gasoline, LPG mixture, and propane. Water scarcity is met by using air or evaporative condensers where feasible. The Claytonville plant operation is automatic to the extent that controls are provided for all pressures, temp, and liq levels. Automatic safety and shutdown devices are used for the operations listed. The one manually-controlled process step is adjusting reflux rate to the lower part of the stabilizer. Essential factors governing the success of the plant—though similar to those in larger plants—require greater scrutiny. R. T.

1513. The Stroud portable plant. O. H. Grimes. *Proc. nat. Gas Ass. Amer.*, *35th ann. Conv.*, 1956, 25–8.—In the Stroud, Oklahoma, portable plant—producing natural gasoline, a butane–propane mixture, and propane—all the pressure vessels are mounted on a single skid. The complete skid includes also process pumps, fractionator reboilers, control equipment, scrubbers, reflux separators, etc. Heat exchange equipment, excepting reboilers, is separately skid-mounted. Additional cost for skids is offset by simpler foundation construction—less concrete. Construction is simple; intricate process piping is complete when the plant units arrive in the field; the remainder is prefabricated and stencilled. Construction and erection steps of a typical small plant are illustrated. A flow diagram of the process is presented. R. T.

1514. Practical economics for refinery mechanical engineers. T. S. Fennema. *Petrol. Engr*, 1956, **28** (13), C3–8.—With a number of examples, the author shows how engineers can profit by attacking problems in a logical, orderly manner. E. A. G. H.

1515. Planned refinery lubrication—a management opportunity. V. M. Stanich and C. W. Pusack. *Petrol. Engr*, 1956, **28** (13), C16–23.—The successful application of lubrication is discussed under 3 main headings: (1) management recognition and backing; (2) development of a workable organization; (3) use of up-to-date technical information. In conclusion, it is stated that management should recognize the direct profitability of thorough maintenance and lubrication problems, as evidenced by the lack of unscheduled equipment problems. E. A. G. H.

1516. Heat exchanger cleaning system. A. R. Dyer and C. A. Faulconer. *Petrol. Engr*, 1956, **28** (12), C9–11.—This was

developed at a Californian refinery to deal with 600 heat exchangers in service. In cleaning the outsides of bundles they are mounted on a pneumatically-driven truck through a housing, fitted with 2 high pressure water nozzles on a swivel arm. Tarry deposits are removed beforehand by washing with hot gas oil. Tube cleaning is accomplished by inserting lances, pushed through tubes by a pneumatic drive motor with friction clutch. E. A. G. H.

1517. Direct-contact gasoline condenser. S. C. Hu. *Petrol. Engr*, 1956, **28** (12), C12–18.—The author initially contrasts direct-contact with indirect-contact coolers before describing a typical gasoline direct-contact condenser. After mentioning applications of these condensers he introduces the general aspects of their design, illustrated with a sample problem. E. A. G. H.

1518. What to do with hydrogen. Anon. *Petrol. Engr*, 1956, **28** (12), C28–32.—Brief points from some of the papers of the American Chemical Society symposium are raised, regarding refinery hydrogen. These include reduction of O.N. loss in hydrodesulphurization, benefits from hydrotreating of cat cracker feeds, and hydrogenation of asphalt for fuel products manufacture. E. A. G. H.

1519. Development of maintenance-cost yardsticks. E. S. Bale, E. L. Mast, and R. E. Wester. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 203–11.—Refinery management needs a method for determining where it stands in maintenance. This need involves both the cost of maintenance and the result of maintenance activity.

Among the several methods of comparing maintenance cost, the authors have found most useful a method using ratios of current cost to capital investment in terms of current dollars. Differences in level of operation, type of process, soundness of design, organization and skill of the mechanical and operating functions—all result in variation of these maintenance ratios.

For several refineries studied, total direct cost ratios ranged from 3 to 5½%. Individual process installations varied between 2 and 7%, apparently depending upon severity of basic process involved. These data show there is less difference between plants on major processing equipment than on " other facilities " which represent *ca* ½ of the usual plant investment.

Studies of methods of measuring maintenance result were not so conclusive. Skilled observation, engineering inspection, safety performance, failure-rate analysis, and other known approaches deal mainly with specific points of maintenance result. Analysis of failures within our refineries shows that they occur in a pattern. The shape of this pattern might help to distinguish good from poor or erratic maintenance performance.

In the area of maintenance result the need remains for overall measures of effectiveness. True long-term optimum maintenance costs will be accomplished only when effective controls are developed for current maintenance in terms of its total effect. (Authors' abstract.)

1520. Air oxidation of sulphides in process waters and caustic solutions. A. G. Smith. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 313–19.—An air-oxidn process has been developed which makes possible the disposal of sulphide-bearing waters without objectionable pollution of either the atmosphere or surface waters. The process involves conversion of sulphides to thiosulphates at elevated temp and pressures. 3 units are now in operation, and oxidize both process waters and caustic soln which contain up to 50,000 p.p.m. of sulphides. In each unit the sulphide concn can be reduced to less than 1 p.p.m. The largest of the 3 units was converted from steam stripping to air oxidn at relatively low cost. Operation of these units is discussed and a brief summary of the process variables presented. (Author's abstract.)

1521. The characteristics of refinery waste waters and methods of their purification. J. Chachulski *et al. Prace Instytutu Naftowego*, 1956, Series B, No. 41, 1–16.—Waste waters from the Trzebinia refinery have been analysed and found contaminated by heavy hydrocarbons, naphthenic acid salts from the crude, and sulphonic acid salts from the refining processes. The latter are causing the emulsification of the former, and such emulsions are most difficult to clear. As purifying agents NaCl, H_2SO_4, CaO, Al··· and/or Fe··· have been used. Tables illustrate the relative effectiveness of these chemicals against particular impurities and also their quantities and cost. As an alternative method, filtration through a bed of slag (or ash), limestone, and coke is recommended. At the correct rate of flow this gives very satisfactory results. M. S.

1522. Biological oxidation and re-use of refinery control waste for pollution control and water conservation. H. F. Elkin. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 340–6.—A new process revision to the water supply and waste-disposal system at the Sun Oil Co refinery, Toledo, Ohio, has been completed. The system provides for comprehensive pollution control of all plant waste waters, reclamation of spent waters for re-use within the refinery with minimum pre-treatment, and a virtually unlimited water supply for emergency fire protection. Waste treatment is accomplished by selective segregation of waste waters at their source, reduction of sulphur cpds and alkalinity, and removal of oil and settleable solids in conventional API separators, followed by 4- to 5-day retention in an impounding basin and biological oxidn in cooling tower systems. The first step in the programme was installation of a flue-gas stripping tower for removal of sulphides in the process waters to be re-used. The second phase of the project consisted of segregating low-alkalinity process waste waters together with storm water from ground run-off. Approx 1500 gal/min of these waters are available for re-use as cooling tower make-up following retention in the separators and impounding basin. High-alkalinity waste waters, not suitable for re-use, are collected in a separate system and discharged after oil removal. The impounding basin also serves as a reservoir for emergency storage for fire-fighting water delivered by 2 high-pressure, 1250 gal/min, diesel-driven, vertical, centrifugal fire pumps. This supply is virtually inexhaustible, in as much as fire water used in the plant can return to the impounding basin via the storm sewer system. Biological oxidn of waste waters during re-use in cooling tower systems has consistently reduced phenols in excess of 99%, and chemical oxygen demand has been substantially lowered. There have been no adverse effects on heat transfer efficiency or on corrosion rates in the tubular cooling equipment. The entire programme represents a new approach to the multiple problems of refinery pollution abatement, water supply, and fire protection. (Author's abstract.)

1523. Waste disposal in retrospect. W. B. Hart. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 347–52.—The work of the API Committee on Disposal of Refinery Wastes since its formation in 1930 has included the following : development and modification of the API refinery-separator design; development of methods for determining oil in refinery effluents; studies on neutralization of stream-pollutant acids and alkalis in refinery wastes; and development of a biological stream survey technique and of analytical methods for pollutants, *e.g.* phenols, in waste waters. (Author's abstract.)

1524. Water purification at Toledo refinery. H. F. Elkin. *Petrol. Engr*, 1956, **28** (11), C38–42.—Refinery expansion necessitated a larger water supply and additional treatment of waste water. In preference to a larger intake of city water or further river-water treating equipment it was decided to re-use waste waters. A flue gas stripping tower for the re-

moval of sulphides from process water was installed, low alkalinity process waste water was segregated together with storm water from ground run-off, and also an impounding basin was built making available some 600 gal/min of storm water. Waste treatment is accomplished by selective segregation at source, removal of oil and settleable solids in API separators, followed by 4- to 6-day biological oxidn treatment in cooling tower systems. These processes have resulted in the refinery satisfying 40% of its water requirements from within. E. A. G. H.

1525. Treating refinery effluents. E. G. Rawlings. *Petroleum, Lond.*, 1957, **20** (4), 125–8.—Initially, the compositions of effluents obtained in refinery and petroleum chemical processes are dealt with, mention being made of the presence of sulphuric acid and various oils in both cases. Neutralization of acid is achieved by batch treatment with lime, continuous flow of effluent over a lime-bed, and the continuous mixing of streams of effluent and milk of lime with automatic control based upon the inlet effluent flow rate and pH value. Corrosive effects of effluents on treatment tank construction materials, channels and pipelines, and ancillary equipment are discussed. Special reference is made to processes employing hydrofluoric acid. E. A. G. H.

DISTILLATION

1526. Distillation improvement by control of phase channelling in packed columns. R. E. Manning and M. R. Cannon. *Industr. Engng Chem.*, 1957, **49**, 347–9.—The effect of fitting inter-distributors was investigated in a 6-inch dia column, packed with varying heights of protruded stainless steel packing. Channelling was reduced and the efficiency considerably increased, depending on the vapour velocity and the number of inter-distributors. The inter-distributors consisted of a flat plate carrying riser tubes surmounted by conical screens. A flat screen was found to be useless as a distributor, as it caused the column to flood at 50% of its normal flooding velocity. D. B. S.

CRACKING

1527. Cyclic catalytic reforming process. C. G. Milbourne and C. B. Glover. *Industr. Engng Chem.*, 1957, **49**, 387–91.—This process may be used to reform natural gas, propane, butane, gasoline, naphtha, and kerosine to produce high hydrogen content gases suitable for blending with low quality gases. A typical unit is described, the cat used being a stationary bed of nickel. Diesel oil, gas oil, and Bunker C oil have also been used and gases of 500–1000 B.t.u/cu. ft. obtained using a special cat. D. B. S.

1528. Comparison of catalysts in cracking pure methyl-*cyclo*hexane and *n*-decane. C. J. Plank, D. J. Sibbett, and R. B. Smith. *Industr. Engng Chem.*, 1957, **49**, 742–9.—The effect of cat type on the product distributions in gas oil cracking was investigated by cracking pure methyl *cyclo*hexane and *n*-decane at 495° C and atm pressure over silica–magnesia, silica–alumina, and silica–alumina fluoride cat. The products were analysed in detail, and it was shown that the latter cat was the most active and the first-named the least active for the most important reactions, namely, carbon chain splitting, hydrogen transfer, and isomerization. Other factors, such as coke and aromatic formation, are also discussed. It is suggested that the cracking of methyl *cyclo*hexane is initiated by a Lewis acid mechanism and that the silica–alumina fluoride cat has a greater concn of Lewis sites than the silica–alumina and silica–magnesia cat respectively. D. B. S.

1529. Naphtha processing over platforming catalyst—the effect of sulphur on catalyst life. W. K. Meerbott *et al. Industr. Engng Chem.*, 1957, **49**, 650–5.—The effect on cat life of the sulphur present in straight-run naphthas used as a feedstock for a platforming process was investigated. At 600 p.s.i. and 900° F satisfactory cat life could be realized if the feedstock was desulphurized to <0·07 wt % sulphur, but above this figure the life was reduced. At 0·17% sulphur the activity declined rapidly. At lower pressures there was an increased yield of product, but the cat activity declined more rapidly and offset this. D. B. S.

1530. Experiences in determining the activity of cracking catalysts after the "Cat-A-Test"-method. (In German.) P. W. Schenk. *Erdöl u. Kohle*, 1956, **9** (8), 524–7.—Experiences with a proposed standard procedure for cat evaluation—the "Cat-A-Test"—are described. Advantages are simplicity of the apparatus and speed of the test. Actual cracking takes 10 min, the whole test including regeneration time *ca* 3 hr. 50 ml standard gas oil are cracked over 200 ml cat at 427 ± 3° C—chosen arbitrarily—in 10 min, corresponding to a vol rate of 1·5 vol/hr/vol cat. The liq cracked products are separated from the gaseous, and coke deposited on the cat is burned off in an air stream. Liq products are dist in the standard apparatus illustrated and described. A diagram of the test apparatus is given. In the experiments described—with tabulated results—bead cat were used. The results were obtained on samples taken from the same cat, in various lab. R. T.

1531. Residuum hydrocracking. D. H. Stevenson and H. Heinemann. *Industr. Engng Chem.*, 1957, **49**, 664–7.—A process for the continual hydrocracking of residua diluted with a light hydrocarbon such as butane at 3500 p.s.i.g. is described. Cat life was long and high yields of saturated light and middle dist were obtained with a relatively low hydrogen consumption. A large number of cat were tested and one of cobalt–molybdena on alumina was found to give the best overall results, although the O.N. of the gasoline obtained was somewhat lower than that for other cat; such gasolines may, however, be conveniently reformed. At the moment the process is high in investment cost, but it may become economical as changes occur in the demands for light saturated products relative to residual fuels. D. B. S.

HYDROGENATION

1532. Refining of diesel power fuels by catalytic hydrogenation. (In German.) F. Schmeling. *Erdöl u. Kohle*, 1956, **9**, 450–6.—Cat hydrogenation for selective separation of petroleum S—developed by Esso Research and Engineering Co—is described. The cat is highly active at relatively low pressure and temp, therefore only mild steel construction is required. The cracking out of combined S as H_2S and saturation of residual mol is attained with improvement of product smell, storage, and colour stability and motor properties. No notable action on mol structure results. The *d* and cold behaviour change very little. Losses compared with other processes for S extraction are small. By-products present no difficulties, the chief one, H_2S, being washed out easily. Hydrogenation of aromatics occurs to only a small degree, but olefins are saturated and mercaptans and aliphatic and cyclic sulphides are decomposed. H_2 consumption is high. In refineries operating at cat Reformer H_2 of 85% purity is available. Esso requires a special H_2 installation. R. T.

1533. Decomposition of the sulphur compounds of a high-sulphur mineral oil distillate by catalytic hydrogenation. J. Varga, I. Szebenyi, and E. Kocsis. *Proc. Hung. Acad. Sci., Chem. Sect.*, 1957, **8** (2–3), 351–6.—As earlier data in the literature refer only to decomposition of model sulphur

cpds, experiments were made with the gas-oil dist fraction (boiling range, 170°–356° C; sulphur content, 0·49%) from a high sulphur Hungarian crude. The experiments were made at 400° C and at 10 and 40 atm initial H_2 pressure in the presence of Fe_2O_3, Cr_2O_3, MoS_2, WS_2 $CoMoO_4$, NiS–WS_2–Al_2O as cat. It was established that the most effective cat were WS_2 and Ni–WS_2–Al_2O_3, followed by $CoMoO_4$ and MoS_2. These first 2 gave complete desulphurization at 400° C and 40 atm pressure. When using $CoMoO_4$, the product contained 0·005% mercaptan-sulphur, 0·04% sulphur bound in aliphatic, and 0·005% bound in aromatic sulphides; "residual" sulphur cpds (thiophenes and homologues) could not be detected.

Dilution of the gas-oil with tetralin proved to be very advantageous in all cases. In the presence of $CoMoO_4$ cat a 1:1 mixture of tetralin and gas-oil gave at as low a pressure as 1 atm a product of 0·08% sulphur content, while at a pressure of 10 atm, both $CoMoO_4$ and NiS–WS_2–Al_2O_3 cat showed complete desulphurization. Without tetralin at 400° C and 10 atm H_2 pressure the sulphur content of the product was 0·31%. W. R. H.

1534. General purpose hydrogenation pilot plant. R. S. Manne, H. G. Boynton, and A. M. Souby. *Industr. Engng Chem.*, 1957, **49**, 640–5.—A general purpose hydrogenation plant which will handle 0·5–3·0 b.d. is described in detail. The unit will handle a wide range of feedstocks and may be operated over a wide variety of conditions, including pressures up to 800 p.s.i., temp to 850° F, charge ratios between 0·5 and 4·0 vol oil/hr/vol of cat, and recycle gas rates of 0–6000 s.c.f/brl of oil charged.

A continuous vacuum flash tower permits bottoms having a b.p. >1040° F to be recycled if desired. Provision is also made for studying the regeneration of the cat. The instrumentation and safety devices are described. D. B. S.

1535. Hydrofining thermally cracked naphthas. E. J. Hoffmann, E. W. Lewis, and E. F. Wadley. *Industr. Engng Chem.*, 1957, **49**, 656.—Pseudo-kinetic equations were obtained to express the relative degree of mono- and diolefin hydrogenation when thermally-cracked naphthas were hydrogenated over a nickel–tungsten sulphide cat. Conditions investigated ranged between 400° and 550° F, 40 and 200 p.s.i.g., 3 and 18 vol oil/hr/vol of cat, and hydrogen rates from 100 to 400 s.c.f/brl of feed. Results may be used to obtain a hydrogen rate which will give max selectivity in the hydrogenation reaction. A relation between the research O.N. and the bromine number and sulphur content was also found.
D. B. S.

1536. Hydrogenation of asphalt for fuel products. G. T. Gwin *et al.* *Industr. Engng Chem.*, 1957, **49**, 668–72.—Petroleum asphalt residues were cat hydrogenated in a pilot plant at pressures of 200–800 p.s.i.g. to give dist fuel products such as gasoline, light heating oil, and gas oil for cat cracking. Asphalt conversions of up to 70% were obtained using a cobalt–molybdena on alumina cat. The cat had an excellent life and maintained its activity, and the products were of high quality due to the desulphurization accompanying the asphalt conversion. The process variables are discussed and optimum operating conditions and mechanisms for the changes in chemical structure suggested. It appears that the economics of a commercial scale unit would be favourable.
D. B. S.

1537. Hydrogenating shale oil to catalytic reforming stock. P. L. Cottingham, E. R. White, and C. M. Frost. *Industr. Engng Chem.*, 1957, **49**, 679–84.—High octane gasolines have been obtained from Colorado shale oil by the hydrogenation of gas combustion crude at 3000 p.s.i.g. and 1010° F. Yields for the single pass operation were approx equivalent to those obtained by the recycle thermal cracking of crude shale oil, but the O.N. was superior and the sulphur and nitrogen content lower. The effect of hydrogenating temp on the composition, O.N., and sulphur and nitrogen content of the gasoline, and the yield of products was investigated at temp between 760° and 1010° F. Product quality was better at the higher temp, but the total liq yield lower, and it appeared that a temp of *ca* 900° C was the most satisfactory.
D. B. S.

1538. Gasoline production from coal tar oils. H. Clough. *Industr. Engng Chem.*, 1957, **49**, 673–8.—The Billingham plant of I.C.I. which produces gasoline by the hydrogenation of creosote is described. Developments in the process and cat used over the past 21 years are described; these have enabled the process to keep abreast of the gasolines obtained from petroleum, and gasolines of 100 O.N. are now feasible. The process is flexible, not only in the feedstock, which includes coal tar oils obtained from high and low temp carbonization and from shale retorting, but also in the products produced, which have ranged from fuel oils to aviation gasolines. It appears that the most urgent problem in this type of process is the need for a cheap method of obtaining hydrogen from coal. D. B. S.

POLYMERIZATION

1539. Polymerization of light hydrocarbons. Recent progress in refinery processes. 2. P. W. Sherwood. *Petroleum, Lond.*, 1957, **20** (5), 183–6.—In this paper further processes are described with techniques, including some experimental cat. Examples quoted are: (1) propylene-combining gases over 85–109% liq phosphoric acid at 175° C and 600 p.s.i. to give propylene polymers; (2) the separate polymerization of propane–propylene mixtures and ethylene over nickel oxide–silica–alumina at various temp and pressures; (3) the polymerization of propylene over silico-tungstic acid at pressures up to 100 atm and temp under 160° C. Variations of product yield with reaction variables are discussed.
E. A. G. H.

1540. New and advanced developments in tetramer, cumene, and motor polymer manufacture. G. Egloff and E. K. Jones. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 1–7.—Cat polymerization using UOP solid phosphoric acid cat was first developed for the petroleum refining industry for the production of high octane motor gasoline from waste refinery cracked gases. However, it is now rapidly expanding into the petroleum chemical field, and includes the production of such chemicals as tetramer, cumene, butyl benzene, ethyl benzene, etc. The economics of producing these petroleum chemicals are even more attractive than producing motor fuel polymer. Simplified units have now been constructed which will make cumene, tetramer, butyl benzene, or motor polymer in the same unit in blocked-out operation. However, process details in this article will be limited to tetramer, cumene, and motor polymer. The equipment required for producing these 3 products is essentially a charge pump, heat exchangers, cat chamber, depropanizer, debutanizer (or recycle column), and re-run columns. The operation consists of charging fresh propane–propylene feed and recycle to the cat chamber and fractionating the effluent into spent propane, recycle, re-run bottoms, and the cumene, tetramer, or motor fuel polymer product as the case may be. Conversion of the propylene in the fresh feed averages 92–98% for the various processes, with conversions at the end of the run ranging from 90 to 96%. Tetramer produced by the process can be made into the most popular of all detergents, the alkyl aryl sulphonate type. Benzene is alkylated with the tetramer into dodecyl benzene as the second step in this process. Cumene is beginning to have wide usage as a raw material in the production of phenol and acetone by the oxidn process.

Sufficient make-up benzene is charged to the cumene unit to complete the reaction with the propylene.

(Authors' abstract.)

ALKYLATION

1541. Blitzing alkylation problems. 3. How-to's on reducing corrosion. L. Resen. *Oil Gas J.*, 22.4.57, **55** (16), 116.—Problems discussed include corrosion reduction in alkyl and alkylate fractionators and how to increase contact time in caustic-wash system and reduce corrosion. Solutions involve use of alloys, plastic linings, inhibitors, and change in caustic strength. G. A. C.

CHEMICAL AND PHYSICAL REFINING

1542. Hydrodesulphurization catalyst studies. W. A. Wilson, W. E. Voreck, and R. V. Malo. *Industr. Engng Chem.*, 1957, **49**, 657–60.—Cat removal of sulphur and nitrogen from naphtha is evaluated by considering the hydrogenation, over a commercial cat, of a soln of dibenzothiophene and 3-methyl-*iso*quinoline in both virgin and thermally cracked naphthas. A process correlation is developed which holds for naturally occurring sulphur and nitrogen cpds in thermal naphtha. These studies may be used to evaluate cat activity and to aid the selection of cat and design of hydrodesulphurization units. D. B. S.

1543. Hydrotreating cracking stocks. C. R. Eberline, R. T. Wilson, and L. G. Larson. *Industr. Engng Chem.*, 1957, **49**, 661–3.—The cat-cracking characteristics of a high-sulphur virgin gas oil, a gas oil from visbreaking residuum, and a low-sulphur virgin gas oil were considerably improved by a pretreatment involving a mild cat hydrogenation at pressures as low as 500 p.s.i.g. Carbon deposition was found to be decreased up to 30% during cracking at 50% conversion, and in addition the amounts of contaminants, such as the heavy metals and nitrogen cpds, were reduced, resulting in increased cat life. The sulphur removal was from 78 to 92% for the high-sulphur gas oil and the production of corrosive hydrogen sulphide during the cracking virtually eliminated, thereby giving improved cracked products. D. B. S.

1544. Desulphurization and refining of naphthas by metallic sodium. B. M. Vanderbilt. *Industr. Engng Chem.*, 1957, **49**, 696–703.—Virgin and cracked naphthas have been desulphurized using metallic sodium. Virgin naphthas are best treated in the vapour phase at atm pressure and between 500° and 550° F by using the sodium on a solid support such as sodium sulphide or limestone. Desulphurization down to <10 p.p.m. was achieved with naphtha recoveries of over 99·5%. Liq phase treatment, at temp as low as 320° F, was found to be more satisfactory for cracked naphthas when a suitable dispersing agent and an alcohol activator were used for the sodium. Mild desulphurization of cracked naphthas may be achieved using solid supported sodium, and a pretreatment of the naphtha with 85% sulphuric acid was found to reduce the deposits to the same level as those obtained when treating a virgin naphtha. D. B. S.

1545. Selective hydrodesulphurization of cracked gasolines. F. W. Kirsch, H. Heinemann, and D. H. Stevenson. *Industr. Engng Chem.*, 1957, **49**, 646–9.—Cat-cracked gasolines of high sulphur content may be desulphurized without loss of O.N. by hydrogenating the high-boiling, sulphur-rich, and olefin- and aromatic-poor fraction of the gasoline over a cobalt–molybdena–alumina cat at 300 p.s.i.g. These fractions may then be blended with untreated fractions to give fractions suitable for further blending in the refinery. Factors affecting cat selectivity and life, and the use of inhibitors for preventing olefin saturation are discussed. Cat life, prior to regeneration, is estimated at 100–120 brl of total low-sulphur gasoline/lb of cat. D. B. S.

SPECIAL PROCESSES

1546. Operation and performance of bench scale reactors. J. R. Snyder, P. F. Hagerty, and M. C. Molstad. *Industr. Engng Chem.*, 1957, **49**, 689–95.—The effect of agitation on the operation and performance of bench scale reactors was investigated using 2 reactions—the hydrogenation of nitrobenzene to aniline in an acetic acid solvent with a palladium on charcoal cat, and the oxidn of aq sodium sulphite with pure oxygen using a cupric ion cat.

4 methods of agitation were used, namely, shaking or rocking of the entire vessel and dashing or rotating an impeller within the vessel, and the effect of agitation speed and filling ratio (vol of liq/vol of reactor) studied. Reactors using a rotating or dashed impeller were found to be superior to other types, as they achieved a high rate of gas absorption and had a high useful vol due to the "positive" agitation which impellers impart. A new design for a rotating gas-pump impeller which will disperse both gases and solids is also described. D. B. S.

1547. Low temperature recovery of hydrogen from refinery gases. D. F. Palazzo, W. C. Schreiner, and G. T. Skaperdas. *Industr. Engng Chem.*, 1957, **49**, 685–8.—A plant for producing hydrogen of greater than 99·9% purity from reformer off-gases is described. The process is carried out at low temp and after an initial cooling to −270° F, in which the bulk of the hydrocarbons are condensed out, the gas is washed with liq propane to remove the final traces, the propane being regenerated by stripping it with part of the product. Any nitrogen, carbon dioxide or monoxide, or acetylene impurities which are occasionally present should be removed by separate treatments. The plant will produce 10,000,000 s.c.f. of hydrogen/day, and may also be adapted to produce synthesis gas for ammonia production. D. B. S.

1548. Chlorination of emulsion–polymerized polybutadiene rubber. P. J. Canterino. *Industr. Engng Chem.*, 1957, **49**, 712–17.—The chlorination in carbon tetrachloride soln of polybutadiene and butadiene–styrene copolymers was investigated. Chlorinated polybutadiene was found to possess greater acid and alkali resistance and also higher tensile strength than chlorinated natural rubbers, and partial chlorination of a butadiene–styrene copolymer gave a rubber-like product that could be vulcanized to a stock having an exceptionally high tensile strength. Other properties are described. D. B. S.

1549. Production of vinyl chloride by chlorinating ethylene. (In German.) W. Ohme. *Erdöl u. Kohle*, 1956, **9** (8), 521–4.—The most favourable operating conditions and expected vinyl chloride yields in C_2H_4 chlorination are investigated. Direct chlorination of low-C_2H_4-cont gas mixtures—2–3 vol%—is operationally and technically possible without difficulty. With regard to the economical practicability of the process, the optimum operating conditions give a C_2H_4 conversion of 75–80% with Cl_2 consumption 70–80%. In C_2H_4 chlorination in gas mixtures with higher C_2H_4 concn the most favourable conditions yielded C_2H_4 conversion from 86 to 87% with Cl_2 consumption 70–80% by this method. Gas mixtures with 15–35% C_2H_4 cont are obtained economically from low cont gases, *e.g.* coke-oven gas, by inserting an activated-C unit. In this case a smaller chlorination apparatus can be employed. Conversion of ethylene dichloride to vinyl choride in the liq phase is possible—with good product yields—under the action of aq NaOH soln in presence of definite materials as reaction supporters *e.g.* mono- or divalent phenols. This process permits production

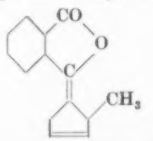
of vinyl chloride or polyvinyl chloride from C_2H_4-containing gas mixtures without previous separation of pure C_2H_4.

R. T.

1550. World's first hydrodesulphurizer. W. Sekules. *Petrol. Engr*, 1956, **28** (11), C17–18.—The first unit of this type deals with low-sulphur dist at the Shell refinery, Stanlow. 3 important economy features relate to: (1) trickle feedstock technique over fixed cat bed and low hydrogen recycle rate, saving 15–20% over gas phase hydrogenation; (2) sulphur removal of 85–90% is obtained; (3) the 5% feed converted to high octane gasoline (O.N. >100) as by-product. A simplified process flow chart is given. E. A. G. H.

1551. Dehydrogenation of secondary alcohols in liquid phase. Elements of rational calculation of an industrial reactor. F. Coussemant. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 261–70.—The dehydrogenation of secondary alcohols has led to research and industrial operations for the purpose of producing the corresponding ketones. It is usually carried out by a reaction in the gas phase at 400°–450° C on cat such as zinc oxide. These conditions are a thermodynamic necessity, high temp being required to achieve a satisfactory reaction equilibrium. This thermodynamic necessity can be sidetracked if the equilibrium is shifted by eliminating one of the products (hydrogen). To make this elimination practically automatic a process in liq phase must be adopted. Lab studies have shown that the difficulty lies in the kinetics of the reaction, and revealed that the reaction is uninhibited by the other product, namely the ketone formed. It was thus possible to determine the law governing this reaction, to figure out the parameters on which it depends and their variation with the temp and the different possible couples of secondary alcohols–ketones. Following these studies, the Institut Français du Pétrole has developed an industrial process for the dehydrogenation of secondary alcohols which can be employed for manufacturing all kinds of ketones. It is a liq phase process carried out at a temp of *ca* 150° C and free from marginal reactions so that the output is practically 100%. Other advantages of this process are: its very simple equipment involving small capital investment, the extremely small number of employees required for manufacturing and maintenance purposes, low consumption of heat and mechanical power. A semi-industrial continuous cycle ketone production plant is at the present time operating at the Institut Français du Pétrole. An industrial plant has been built, and has been now in operation for *ca* a year. The lab research work and advantages listed above have thus been confirmed in practice. (Author's abstract.)

1552. Friedel-Crafts syntheses with aliphatic and hydroaromatic hydrocarbons. H. Hopff, E. Baserga, R. Roggero, and H. Bosshard. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 249–52.—Contrary to the behaviour of aromatic hydrocarbons, aliphatic and hydroaromatic hydrocarbons react with carbon monoxide in the presence of anhydrous aluminium chloride with formation of ketones. The present paper describes new Friedel–Crafts reactions with aliphatic and *cyclo*aliphatic hydrocarbons, especially with phthalic acid anhydride and sulphur. *cyclo*Hexane gives with phthalic acid anhydride a carboxylic acid anhydride with the formula:



Sulphur reacts with *n*-pentane and *cyclo*hexane to mercaptans and especially to sulphides, whereby partial rearrangement and cleavage of the hydrocarbon chain occurs.

(Authors' abstract.)

1553. New developments in hydrocarbon synthesis. H. Kölbel, P. Ackermann, and F. Engelhardt. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 227–47.—The cat synthesis of hydrocarbons from gases containing carbon monoxide has been investigated by the authors in 2 different types of operation: one being a development of the well-known CO-hydrogenation according to Fischer–Tropsch, the other one involving the direct conversion of carbon monoxide with water vapour. A feature common to both processes is that they are preferably carried out in a liq medium. On the basis of the most recent findings, especially of a physical nature, the phenomena encountered in cat gas reactions in the presence of a liq medium are described. Evidence is furnished of the particular desirability of the bubble column with suspended cat as used by the authors, which has also proved satisfactory in a semi-industrial demonstration plant. Results are given both of this demonstration plant and of bench-scale tests carried out on the direct conversion of CO with H_2O vapour. The synthesis of hydrocarbons from carbon monoxide and water vapour will find its obvious field of application in all those cases where technical gases containing carbon monoxide, even in rather low percentages, such as blast-furnace gas, are obtained in a form which does not permit their economical utilization by other means. (Authors' abstract.)

1554. Oxo-synthesis. Some aspects of the process. I. Dakli. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 119–25.—Some aspects of the Oxo-synthesis process on low mol. wt. olefins are discussed. In particular, the problems relating to recycle gases, to the fractionation of the products, and to the recovery of exhausted cat are considered.

(Author's abstract.)

1555. Catalytic gasification of heavy fuels for the obtaining of ethylene and propylene. M. Patry, E. Luzarreta, and C. Paul. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 15–22.—2 methods are set forth: the first process is termed semi-continuous and consists of a preliminary treatment of the heavy oil by steam in a flashing dist apparatus, in order to separate the volatile hydrocarbons from the heavier components. The volatile hydrocarbons are processed by thermal cracking in the presence of steam in tubes heated from the outside by flue gases proceeding from combustion of the heavy components. Reaction occurs at a temp between 450° and 800° C in the presence of a contact mass, such as magnesium or translucid quartz. The gases obtained contain from 40 to 55% of olefins. Fuel injection is stopped at regular intervals to allow the steam to eliminate carbon deposits on the contact mass. The proportion of ethylene to propylene is *ca* 5 to 1. Starting with one kg of heavy fuel, *ca* 130–150 g of gaseous olefins are obtained. Moreover, combustible gases are recovered as well as tars, which, mixed with the heavy products not used for heating, represent a liq fuel of value. The second method is a cyclic one. It originates from the processes for cat and cyclic cracking of fuel oil, developed by the authors, to produce mixed gas and town gas. During the conversion stage, the carbon deposited on the cat supplies a considerable part of the heat necessary for running the process. Starting with one kg of No. 2 heavy fuel, *ca* 275 g of gaseous olefins are obtained. As with the previous method, combustible gases and liq are recovered. (Authors' abstract.)

1556. Molybdenum in petroleum refining. 1. B. H. Danziger and J. R. Milliken. *Petrol. Engr*, 1956, **28** (12), C3–8.—In this article the growing usage of molybdenum in reforming processes for octane improvement and desulphurization methods is considered, especially in view of its resistance to common cat poisons. Desulphurization is discussed in respect of the Autofining, Unifining, Hydrobon, Hydrofining, and " Trickle " processes. E. A. G. H.

PRODUCTS

CHEMISTRY AND PHYSICS

1557. Free-radical reactions in hydrocarbon chemistry. E. C. Kooyman. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 189–98.—It is pointed out that many phenomena in petroleum chemistry are attributable to free-radical reactions, and that it is hence important to have information on the relations between structure and reactivity of hydrocarbons towards free radicals. A number of structural factors are discussed, namely, the strength of chemical bonds, the presence of polar groups and of ring systems, and the geometry of the molecule. The important contributions of theoretical chemistry in clarifying the influence of these factors are emphasized. This general information is then applied to specific cases, such as the oxidn and the deterioration of oil products and the action of anti-oxidants, as well as to a number of synthetic methods in the petroleum chemical industry. (Author's abstract.)

1558. New research in the field of olefin chemistry. G. Natta. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 271–90.—The opening of a cracking plant at Ferrara has made considerable quantities of olefins available for the Italian chemical industry. Particular interest therefore attaches to the progress made in research on the use of these products as raw material for the chemical industry. The Institute of Industrial Chemistry at the Milan Polytechnic School has for over 10 years been carrying out researches in this field, and a review is given of the progress achieved with the synthesis of oxygenated cpds starting from olefin and carbon monoxide, and with the polymerization of olefins to high mol. wt. polymers.

Research on the synthesis of oxygenated cpds starting from olefins and carbon monoxide and mobile hydrogen cpds. In the field of Oxo-synthesis the study of the reaction kinetics enables the author to find the optimum conditions for operating at lower temp and pressures than those commonly used. At 110° C and at a prefixed hydrogen partial pressure the highest reaction rate has been found for a carbon monoxide partial pressure of 8–10 atm. By the use of preformed cobalt carbonilic cpds as cat, lower temp could be used for the synthesis of esters from olefins, carbon monoxide, and alcohols. In these conditions secondary reactions, which were among the main troubles encountered in the practical operation of the process, could be almost completely suppressed. It has been found that esters above the methyl are most conveniently obtained by preparing methyl esters from olefins, carbon monoxide, and methanol at first, and then by submitting these products to a transesterification process with higher alcohols, while methanol is recovered and recycled. Substantial progress has been obtained in the synthesis of polycarboxylic esters, ketones, and ketoesters from carbon monoxide and acetylene.

Research on the polymerization of olefins. The use of new heterogeneous cat has opened the way to decisive progress in olefins polymerization. Research carried out by the Institute of Industrial Chemistry in collaboration with the Montecatini Co has succeeded in obtaining for the first time very high mol. wt. solid polymers from olefins of the type R–CH–CH_2, such as propylene, α-butene, α-pentene, α-hexene, etc. According to operating conditions 2 distinctly different types of high polymers, with different yields, are obtainable. The first type (*iso*tactical polymer), with an exceptionally regular structure, appears highly crystalline at room temp. In the case of the polypropylene and polybutene the polymers are particularly suited for moulding and spinning. *iso*Tactical polypropylene fibres possess mechanical properties comparable with those of the best fibres currently on the market. The second type of polymer, while substantially linear, has nevertheless a less regular structure than the first, cannot be crystallized, and appears eminently suitable for producing elastomers. Multi-purpose uses of α-olefin polymers, interesting mechanical properties, and low cost of the original monomers will undoubtedly introduce new trends in plastics and in artificial fibres. Physical properties of the products obtained in these reactions are also discussed.

(Author's abstract.)

1559. Modern methods of acetylene and olefin chemistry in the BASF at Ludwigshafen on Rhein. W. Reppe. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 291–325.—The introduction to the lecture shows how the author, commencing with ethylene chemistry, especially ethylene chloride, arrived, by way of vinyl chloride, at the synthesis of vinyl ethers from vinyl chloride and sodium alcoholates and the work with acetylene under pressure, thus producing vinyl ethers directly from acetylene and alcohols. Then the 4 principal fields of work are dealt with, *i.e.* vinylation, ethynylation, carbonylation, and the cyclic polymerization of acetylene. These have been developed from the reactions of acetylene, principally under pressure, with other cpds. It is also shown how the experiences assembled during the carbonylation of acetylene could be carried over to the olefin substances and how, from the carbonylation of the olefins, the reactions of carbon monoxide with alcohols, olefins, and ring-type ethers and lactones proceeded. Particularly characteristic for the fields of work mentioned, apart from the application of acetylene under high pressure, is the application of new types of cat, *e.g.* copper acetylide in the case of ethynylation and metal carbonyls and metal hydrocarbonyls in the case of carbonylation. Within the framework of the carbonylation reactions, new complex cat are described. These cat excel in their efficiency under mild reaction conditions and their selectivity. Particularly surprising is the synthesis of *cyclo*-octa-tetraene from acetylene (cyclic polymerization), which has contributed to the development of the 8-atoms ring chemistry.

(Author's abstract.)

1560. Thermal conductivity of liquids. D. K. H. Briggs. *Industr. Engng Chem.*, 1957, **49**, 418–21.—The thermal conductivities of over 20 commercial tar dist were found to be correlated over the range 20°–150° C by the equation:

$$K = \frac{32\text{–}0{\cdot}02t}{10^5} \quad \frac{\text{cal}}{\text{cm sec } ^\circ\text{C}}$$

where K = thermal conductivity and t = temp (° C). Results agree well with other authors at room temp, but show wide divergence at the higher temp. D. B. S.

1561. Reactions of propylene with mercuric salts. J. L. M. Cordon and V. G. Aranda. *Combustibles (Zaragoza)*, 1956, **16**, 214–34.—Continuation of research project being conducted in Zaragoza section of National Inst of Fuel; the preparation and properties of acetoxy-mercuri-propanal are described. *Cf.* Abs. **1228**, 1955, and **733**, 1956. A. C.

1562. Study and experiences of the partial oxidation of methane with oxygen. C. Padovani, C. Salvi, and A. Fiumara. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 85–102.—Some kinetic aspects of partial oxidn of methane by oxygen and air on cat were studied. Experiments on the thermic effects and CO_2 formation related to the space-velocity confirmed the hypothesis of a 2-stage mechanism according to which products of complete CH_4 oxidn are first formed and subsequently react with the residual methane to CO and H_2. Other experiments showed that the rate of reaction of methane with free oxygen is much higher than that of the reaction with CO_2 or H_2O. This fact, which could appear in opposition with the

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previously suggested mechanism, is attributed to the different energy content. Preliminary experiments in which CH_4 was reacted for very short contact periods with mixtures of free O_2 and labelled CO_2 seem to support the views of the authors on the kinetic. The experimental investigations, together with some thermodynamic calculations, enabled the authors to choose the most advantageous conditions under which the cat conversion of CH_4 with free oxygen can be industrially achieved. (Authors' abstract.)

1563. Thermodynamics and stoichiometry of the partial oxidation of methane with pure oxygen. A. Fiumara and C. Salvi. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 103–18.—The authors have carried out thermodynamic research on the partial oxidn of methane with pure oxygen or with air, and calculated the reaction gas composition at equilibrium, for temp ranging from 800° to 1400° K, at a 1 atm pressure, and for O_2/CH_4 ratios of from 0·555 to 0·715. The minimum O_2/CH_4 ratios by different temp were also determined above which no elemental carbon is formed. (Authors' abstract.)

1564. Recent developments in the study of the organic chemistry of the atmosphere. E. R. Stephens, W. E. Scott, P. L. Hanst, and R. C. Doerr. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 288–97.—A long-path i.r. cell, with which it is possible to detect many cpds in air at concn in the p.p.m. range, is being used at the lab of the Franklin Institute to study reactions of air pollutants. Field studies of the Los Angeles smog by other investigators have shown that photochemical reactions caused by sunlight play an important role in its development. In the lab it has been demonstrated that ozone is formed when mixtures of nitrogen dioxide and an organic cpd in air are irradiated with artificial sunlight. This can account for the abnormal amounts of ozone found in the Los Angeles atmosphere during severe smog attacks. This paper presents the results of further studies on this and other reactions of importance in air-pollution chemistry.

I.r. analysis of the products of the photochemical reaction between nitrogen dioxide and an organic cpd frequently reveals, in addition to bands of known cpds, several unidentified absorption bands which apparently belong to a single cpd produced in significant quantity. Although this cpd is unstable, moderately pure samples of it can be condensed if the reaction products are drawn through a cold trap. Physical and chemical properties of this condensate referred to as cpd X, are consistent with the belief that it is an acyl-nitrogen cpd, but its structure is not unequivocally determined. The importance of cpd X in an explanation of the chemistry of the atmosphere is stressed.

Samples of cat cracked and thermally cracked gasoline were photochemically reacted with nitrogen dioxide in oxygen. Ozone was produced at substantially the same rate in both cases. At low concn the amount of ozone formed was more than twice the initial amount of nitrogen dioxide. Concn of reactants and products was observed as a function of time. An explanation of these results is offered.

Ozone is formed when cpd X is irradiated with or without added gasoline. Ozone formation is slower with added gasoline, perhaps because the olefins present in the gasoline react with some of the ozone. Ozone is also formed when *n*-butyl nitrite is photolysed in oxygen. It is not necessary to have a nitrogen-containing cpd present in order to form ozone, for small amounts are formed when diacetyl in oxygen is irradiated with artificial sunlight. This ozone was identified in the presence of interfering methyl alcohol by a subtraction technique.

The rate of formation of ozone was only slightly changed when sulphur dioxide was present in an irradiated mixture of olefin and nitrogen dioxide. Since the sulphur dioxide disappeared very slowly, it was concluded that neither the ozone, the free radicals, nor any peroxides which are formed will oxidize sulphur dioxide to sulphur trioxide at a significant rate. (Authors' abstract.)

ANALYSIS AND TESTING

1565. Developments in gas chromatography. J. R. Corbin. *Proc. nat. Gas Ass. Amer.*, 35*th ann. Conv.*, 1956, 37–40.—Column fillers and operating conditions are given for adsorption, elution, and partition chromatography. A disadvantage of the adsorption procedure is irreversibility. The slow desorption produces a sharp front and a long tail, the effect being difficult resolution between components, and band shape distortion on the recorder. Model 154 Vapour Fractometer adapted to partition elution for a wide-b.p. range of components is described with supporting flow diagram. Also presented is the 2-sided detector which forms part of a bridge circuit of which unbalance—produced by each separated fraction—is measured continuously by a standard 10-mV recorder. Use of the procedure for qual, quant, and trace analysis is discussed, and a typical analysis of a standard hydrocarbon mixture is given. Examples of chromatogram are presented. R. T.

1566. Separation of volatile organic compounds by vapour phase chromatography. J. L. M. Cordon and G. Z. Lopez. *Combustibles (Zaragoza)*, 1956, **16**, 65–75.—Construction and operation of a vapour phase chromatography apparatus is described, and typical chromatograms of various mixtures given, including alcohols, aromatic hydrocarbons, esters, halogenated derivatives, and light petroleum hydrocarbons. Analyses conducted on 10–50 mg of sample, employing the techniques of direct elution and of partition, and using columns packed respectively with activated carbon and with a mixture of kieselguhr and dioctyl phthalate. A. C.

1567. Thermostability of the sulphur compounds of Nagylengyel gas oil. J. Varga, V. Hesp, and E. Kocsis. *Proc. Hung. Acad. Sci., Chem. Sect.*, 1957, **8** (2–3), 345–50.—The thermostability of a Hungarian gas oil dist (boiling range, 170°–356° C; sulphur content, 0·49%) was investigated in autoclave experiments at 1 atm N_2, 1 and 50 atm H_2 pressure (initial), and at temp of 350°, 400°, and 450° C. The thermostability was also investigated in the presence of Al_2O_3 and 2 Hungarian bentonites (from Komloska and Istenmezeje) at 450° C and 50 atm initial H_2 pressure. Total, elemental, and mercaptan sulphur, as well as disulphides, aliphatic and aromatic sulphides, and the amount of residual sulphur (mainly bound in cyclic cpds) were determined.

On the basis of experiments it was established that: (1) The decrease of total sulphur content at 350° and 400° C was not noticeable. However, considerable decomposition could be observed at 450° C. The efficiency of desulphurization at 450° C and 50 atm initial H_2 pressure was 39%. (2) In the more significant experiments the sulphur content was reduced, but different sulphur cpds were not destroyed to the same extent. No general correlation between type of sulphur cpd and its ease of decomposition could be obtained on changing either the pressure or the temp. However, it was established that the amount of "residual sulphur" (thiophenes and homologues, etc.) decreased by 50% in many cases, decomposing to give mainly aromatic sulphides and, to a lesser extent, aliphatic sulphides and thiols. (3) The decomposition of sulphur cpds is more extensive in the presence of Al_2O_3, and only a part of the original "residual sulphur" cpds and some thiols remained in the products; the aliphatic and aromatic sulphides were completely converted. In contrast to Al_2O_3, decomposition was increased only to a very slight extent when bentonites were present. W. R. H.

1568. Highlights of the NGAA analysis programme. A. J. Miller. *Proc. nat. Gas Ass. Amer.*, 35*th ann. Conv.*, 1956, 40–4.—The importance of analytical accuracy to the natural

gas industry is emphasized. NGAA Analysis Sub-Committee's efforts to improve the accuracy of analyses are discussed. The tabulated results of co-operating firms on 6 samples showed a systematic error in low-temp analysis. An extensive training system was undertaken as described. Analyses by the Thermocon, the Fracton, and elution gas chromatography give hope for speedier, more accurate results. Liq sample No. 7 showed marked improvement, permitting error diagnosis, and giving factual data on new apparatus and techniques. R. T.

1569. Mechanized bottle washing. Anon. *Inst. Petrol. Rev.*, 1957, **11** (125), 141.—An equipment is described for washing 720 bottles/hr. Cost is £700. The apparatus is made by Thomas Hiel Engineering Co, Hull, Ltd., and *ca* 1 year's operations have shown a striking economy in bottle consumption, which has fallen from 40,000 (cost £900) to 18,000 (cost £400). G. A. C.

1570. Instruments, Electronics and Automation Exhibition. Anon. *Petrol. Times*, 24.5.57, **61** (1560), 460.—An account is given of the exhibition at Olympia in May 1957, and includes computers, data handling equipment and systems, flow indicators, recorders and controls, a Salinometer, gas analysis equipment and detectors, and various other petroleum testing apparatus and lab equipment. G. A. C.

CRUDE OIL

1571. Properties of Wyoming crudes. J. J. Pope and R. R. Wilber. *Petrol. Engr*, 1956, **28** (12), C19–24.—The history and geology of the area is related, followed by a discussion of chemical properties of the 2 general types of crude, namely, green highly paraffinic and black, high asphalt content. Finally, their refining characteristics and products are discussed. E. A. G. H.

GAS

1572. Study of the flow of gas in porous media; application to determining the morphology of the rocks. R. Iffly. *Rev. Inst. franç. Pétrole*, 1956, **11** (8), 975–1018.—Apparatus and the preparation and mounting of specimens for flow studies are described, the studies being intended to test the theory set out previously. The errors in the measurement are examined. Measurements of porosity, and of capillary pressures by means of the Purcell and semi-permeable plate, were undertaken in order to determine features relating to the porous structure. Nitrogen and argon were used in the gas permeability measurements.

A series of rocks varying considerably in permeability and porosity was studied. These included sandstones, limestones, sandy limestones, and granite, as well as sands and powders, in order to get diversity in pore form and size.

Various parameters and constants calculated from the experimental data are tabulated, while flow and capillary pressure data are also shown graphically. The flow data in general depart markedly from Darcy's law for gases, and obey a law of the type predicted. In rocks with intergranular porosity, laminar flow holds usually, but in fissured rocks the flow is turbulent. G. D. H.

1573. Acetylene by partial oxidation of methane. E. Bartholomé. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 65–75.—Methane is available in ever-increasing amounts as the main component of natural gas. By incomplete combustion with oxygen it can be converted into acetylene. A part of the methane is converted into carbon monoxide, carbon dioxide, hydrogen, and water. The heat developed by this process is sufficient to increase the temp of the mixture to *ca* 1400° C and to furnish heat for transformation of the remaining methane into acetylene and hydrogen according to the equation $2CH_4 \longrightarrow C_2H_2 + 3H_2 \longrightarrow 50$ kcal. From the resulting gas mixture it is possible to recover acetylene sufficiently pure for chemical syntheses. In 1953, in the U.S.A. and Italy, plants for carrying out the process of a commercial scale were started with great success. (Author's abstract.)

ENGINE FUELS

1574. Burning velocities of bunsen burner flames by the flame-pressure method. L. E. Bollinger, W. A. Strauss, and R. Edse. *Industr. Engng Chem.*, 1957, **49**, 768–73.—The flame-pressure method of determining burner velocities was investigated using hydrogen– and acetylene–oxygen flames, this method having the advantage that it may be used above 20 atm pressure. For both flames the burning velocities derived from flame pressure measurements were lower than those obtained by the conventional bunsen burner method, probably due to the escape of unburned gas from the rim of the burner used. The theoretical equations relating velocity and flame pressure cannot therefore be used, although a correction factor is suggested which would give more accurate results if the escape velocity could be measured. D. B. S.

1575. Spontaneous ignition of *n*-heptane–air mixtures in a steady-flow process. W. E. Bair, D. R. Olson, and L. C. Lichty. *Industr. Engng Chem.*, 1957, **49**, 774–9.—The spontaneous ignition of *n*-heptane–air mixtures was investigated in a heated reaction tube, and it was found that there was a considerable energy release as cool flames as soon as the mixture entered the tube. This caused an increase in wall temp at the expense of heat in the mixture, and the temp continued to build up until spontaneous ignition occurred. Practically all the energy liberation occurred in the first 15% of the reaction tube, and it amounted to 10–40% of the heat value of the *n*-heptane. The effects of air : fuel ratio and residence time on the heat loss rate and of tube temp on the energy liberation are also discussed. D. B. S.

1576. Gasolines: motor fuels. Chapter XIII. V. A. Kalichevsky. *Petrol. Engr*, 1956, **28** (13), C24–32.—In this article the author discusses the gasoline requirements for varying running conditions and associated problems, *e.g.* vapour lock. The anti-knock characteristics are described in terms of O.N., a brief account of its value as a standard being included. Other properties are concerned with the storage stability of gasoline as regards gum formation, colour, and odour with widely differing temp. The main additives mentioned are TEL and, to a lesser degree, tri-cresyl-phosphate. "Accelerated testing" of gasoline products by the oil companies is also described. Finally, gasoline substitutes, mainly alcohol because of its high O.N., are critically evaluated on the bases of heat content and cost. E. A. G. H.

GAS OIL AND FUEL OIL

1577. Fireside deposits in oil-fired boilers. C. Jacklin, D. R. Anderson, and H. Thompson. *Industr. Engng Chem.*, 1956, **48**, 1931–4.—It is shown that there is a definite correlation between the location and the chemical composition of boiler deposits. Fuel oil impurities, methods for analysing the deposits, and mechanisms of the deposit formation are discussed. Results may be used to improve methods of fuel oil treatment. D. B. S.

LUBRICANTS

1578. Lubricant specifications. 2. E. G. Ellis. *Sci. Lubric.*, 1956, **8** (7), 10–12.—AGMA standard specifications for gear oils and BS 489, covering steam turbine oils, are outlined and discussed. J. G. H.

T 2

1579. Some experiments in the lubrication of stainless steels. 2. Friction tests. G. D. Jordan. *Sci. Lubric.*, 1956, **8** (9), 13–16, 18.—The value of friction tests in assessing the relative effectiveness of lubricants is remarked, and the basic requirements in the design of friction-testing equipment are enumerated. Apparatus based on these postulates is described, together with the procedure employed. Temp, friction, and wear values so obtained are presented, and indicate that oil selection is dependent on characteristics of steel and bearing materials used and on design criteria. J. G. H.

1580. Use of highly-consistent greases as lubricants in launchings. (In German.) W-S. Scheel. *Erdöl u. Kohle*, 1956, **9** (8), 527–9.—Details are given of quantity, composition, and mode of application of lub in ship launching. The *Normandie* required over 50 tons of combination lub. The combination lub described have given satisfaction in launchings at the Mecklenburg, Baltic Sea, wharf at surface pressures of 20 tons/in², at −20° C in winter and on hot summer days. R. T.

1581. Evaluating lube oils containing additives. L. G. Wood and H. Buchwald. *Industr. Engng Chem.*, 1956, **48**, 1925–30. —A lab test, which compared favourably with results obtained from an engine test, is described in which the effects of 3 different types of additive on 5 different oils were investigated. The results showed that the response to the additive varied with the type of oil, and that not all additive types behave in the same way with any particular oil. In some cases additive response appeared to depend on the structural groups within the oil, but in others the total sulphur content appeared to be the major factor. D. B. S.

1582. Hydrodynamic lubrication of piston rings and commutator brushes. W. Lewicki. *Engineer, Lond.*, 1957, **203**, 84–6, 122–4.—For sliding or reciprocating parts of machinery such as commutator brushes, piston rings, etc., where in the past a theory based on strictly parallel sliding has been assumed, a new analysis has been developed which postulates convergent sliding. The deviation from parallelism is so small as to be undetectable even by very sensitive physical means, but the analysis reveals that the minute convergence is responsible for something like 100-fold increase in lubricant film thickness in comparison with absolutely parallel sliding and a corresponding decrease in friction. Because the convergence required to do this is so small, it can develop spontaneously, even if the sliding part is thought to be held quite rigidly, say by elastic deformation of the surfaces between which the fluid is entrapped. The friction predicted by the new formulæ is much more in line with experience. A. C.

SPECIAL HYDROCARBON PRODUCTS

1583. Crystal habit of paraffin wax. R. T. Edwards. *Industr. Engng Chem.*, 1957, **49**, 750–7.—It is suggested that below the transition point wax crystals exist in one of 2 plate forms—a soft plastic form with irregular boundaries developed from a hexagonal lattice and a stiffer rhombic form developed from the ortho-rhombic lattice. In the transition range both forms develop, but at higher temp the plates curl to form characteristic needle-shaped crystals. Malcrystalline forms are either transition types or thin imperfect plate forms. The effect of crystal form on the refining properties of paraffin wax is discussed. D. B. S.

DERIVED CHEMICAL PRODUCTS

1584. Routes to ethylene manufacture. J. W. Woolcock. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 9–14.—There is no one best way of manufacturing ethylene in all circumstances. The optimum route in a given circumstance depends on the scale of production required, on the raw materials readily available in a given geographical location, and the use which can be made of co-products which arise in some methods of manufacture. Except in the uniquely favourable circumstances of Texas, U.S.A., where ethane-containing natural gas and refinery gases are amply available, the choice is generally between the utilization of refinery gas and the deliberate cracking of oils in special apparatus to give a max yield of ethylene and other olefins. Increasing attention is being given to the use of non-dist oils, such as crude and reduced crude, for this purpose. The use of these heavy oils raises a number of problems either not met with at all, or only in lesser degree, when cracking light dist oils for ethylene production. (Author's abstract.)

1585. The reactions of olefins. Principal directions in research organization. G. E. Limido. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 23–37.—Among the cpds obtainable from the petroleum industry the olefins form a very important basic material for the chemical industry, both because of the large quantities available as well as the variety of transformations they can undergo. The transformations which give rise to widely different products bring into play numerous types of reactions. In order to produce these cpds economically, rational methods of synthesis should be employed, and the choice of such methods poses extremely important problems of organization in a lab that undertakes this work. This choice can be made only with the aid of a complete knowledge of the reactions involved. The systematization of chemical reactions leads to their classification into distinct kinetic groups which permit the application of certain simplifying principles in their study. The examples chosen from the numerous reactions of olefins studied at the Institut Français du Pétrole illustrate the theoretical and practical advantages of such a classification. The organization of a lab on the basis of such a classification increases its efficiency both in speed and quality of results obtained. (Authors' abstract.)

1586. The recovery and oxidation of isomeric xylenes. W. G. Toland and E. L. Nimer. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 39–54.—Processes used for separating and recovering high purity orthoxylene, metaxylene, and paraxylene from typical mixtures of xylenes manufactured from petroleum are briefly reviewed. Processes for the recovery of orthoxylene by fractional dist and paraxylene by fractional crystallization have reached a high degree of development and are used for large-scale industrial production of these isomers. Methods for the oxidn of xylene isomers, particularly to the aromatic, dibasic carboxylic acids and their derivatives, such as phthalic anhydride and dimethyl *iso-* and terephthalates, are reviewed and discussed. Processes described in greater detail are: (1) the air oxidn of orthoxylene to phthalic anhydride; (2) the air oxidn of meta and/or paraxylene to toluic acids, esterification with methanol to give methyl toluates, air oxidn of the esters to the corresponding methyl hydrogen phthalates, and final esterification with methanol to the dimethyl phthalates; and (3) the nitric acid oxidn of paraxylene to terephthalic acid. (Authors' abstract.)

1587. Chemicals by direct oxidation of hydrocarbons. E. T. Powers. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 55–64.—The subject of this paper, the oxidn of hydrocarbons, is based upon the 4 principal raw materials commercially used: methane, ethane, propane, and butane. A description is given of the more significant of these processes now in operation. The effect of reaction variables (temp, pressure, reaction time, cat, and reactant ratio) upon product yield and distribution is illustrated. The influences of reaction techniques (vapour phase oxidn, cat vapour phase oxidn, and liq phase oxidn) are explained. The effect of reaction techniques on 2 Celanese processes is discussed. Conclusions for future trends are drawn. (Author's abstract.)

1588. Procedure of synthesis by oxidation of hydrocarbons—systems of reactions. J. C. Balaceanu. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 77–84.—The preparation of oxygenated chemical cpd: ketones, acids, starting from hydrocarbon, utilizes a cheap basic material and seems the most practical method of synthesis. Different methods and improvements have been achieved at the Institut Français du Pétrole: (1) in the case of oxidn with chemical agents of olefins to acids, more particularly cyclic olefins; (2) in the oxidn of cyclic ketones produced by auto-oxidn of hydrocarbons in diacids, by nitric acid in a continuous process recirculating the nitrous vapours. But the most rational process is direct oxidn by air or oxygen utilizing the cheapest oxidizing agent. In fact, controlled combustion. However, it demands extremely accurate control on the kinetics of the reaction, which must be limited, otherwise only CO_2 and H_2O will be obtained, and selective, otherwise a series of products will be forthcoming which may or may not be of interest and are costly to separate. By oxidn in liq phase the reaction can be efficiently controlled. A detonating peroxide is first formed which is subsequently decomposed to give the oxygenated product. The author has developed a process for auto-oxidn of aromatic hydrocarbons directly to ketones, by a reaction which avoids any significant concn of peroxide, and is therefore extremely safe. Even with liq oxidn processes, in liq phase, it is impossible to avoid the production of explosive mixtures of gases in the fractionating equipment. Various devices have been developed to do away with all risk, by effecting the reaction and the separation in equipment of dimensions smaller than the critical dia.

(Author's abstract.)

1589. Surface active agents from petroleum—their properties and uses. J. C. Sanford. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 127–40.—This paper reviews the more important surface active agents manufactured by incorporating petroleum fractions or their derivatives in the mol structure. Methods of production and chemical properties are outlined, and illustrations given of the more important economic parts played by the surfactants as related to the ultimate field use of the end products in which the surfactants are incorporated. Special attention is paid to those aspects bearing on Australia's national economy. (Author's abstract.)

1590. Chemicals from acrolein. S. A. Ballard *et al.* *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 141–54.—With the recent development of a process for cat oxidn of propylene, and the resultant potential availability of acrolein as a low-cost petroleum chemical, a study of its chemistry was undertaken. Acrolein possesses a versatility equalled by few commercial chemicals. The carbon–carbon double bond can be reacted with halogens, halogen acids, alcohols, mercaptans, organic acids, water, bisulphites, cpds containing an active carbon–hydrogen bond, and mol hydrogen. The carbonyl group is reacted preferentially with acid anhydrides and hydrogen cyanide, but the selectivity is poorer in reaction with amines, and in oxidn and reduction. By virtue of its conjugate structure, acrolein participates in reactions of the Diels–Alder type, in which it serves either as the diene or the dienophile or forms a dimer by combining both functions. The products from these primary reactions in many cases exhibit a high order of reactivity approaching that of acrolein itself. Thus a pyramid of chemical intermediates becomes available with potential applications in such diverse fields as supplements for poultry feeds, cloth treating agents, and synthesis of sulphadiazine. Acrolein seems destined for a place, together with ethylene oxide, acetone, and allyl chloride, as a petroleum chemical serving almost all branches of the chemical industry. (Authors' abstract.)

1591. Polyethylene. R. E. Burk and D. E. Strain. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 167–75.—From the small beginnings in England in 1939 the manufacture of polyethylene has grown until the present manufacturing capacity in 6 countries has reached several hundred million pounds/year. Polyethylene has won broad markets in the packaging, pipe, paper, general moulding, container, and electrical fields. This results from its moderate cost, ease of fabrication, good resistance to solvents and chemicals, attractive appearance, freedom from odour and taste, good electrical properties, and other valuable properties. Intensive technical studies have shown that the properties of polyethylene can be varied by altering the proportion of short- and long-chain branches on the polymer chains, as well as by variation of mol. wt. and mol. wt. distribution. (Authors' abstract.)

1592. The manufacture of acrylonitrile from natural gas. J. T. Thurston, E. L. Carpenter, and F. Derbenwick. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 177–87.—Practical and economical methods of production and manifold uses for acrylonitrile have been developed since its discovery some 60 years ago. With the potential advantages to be attained through the usage of natural gas, the American Cyanamid Co has developed an integrated plant using this raw material to manufacture both acetylene and hydrocyanic acid and acrylonitrile from these intermediates. A 99·5 mol % acetylene is obtained through partial oxidn of methane and is recovered from the quenched burner gas by solvent extraction. Hydrocyanic acid is produced by igniting a mixture of natural gas, air, and ammonia on a hot platinum alloy gauze. Following removal of unreacted ammonia by absorption in sulphuric acid, the hydrocyanic acid gas is absorbed in water and recovered by dist as an approx 98% pure product. In a liq phase reaction acetylene and hydrocyanic acid are then combined, in the presence of a cat, to form acrylonitrile. The many possible side reactions and the cat composition are controlled. Acrylonitrile is separated from unreacted acetylene, hydrocyanic acid, and other by-products by absorption, stripping, and dist operations. Thus natural gas, by a combination of 4 processes, is converted to acrylonitrile, a monomer of increasing importance. (Authors' abstract.)

1593. The manufacture of chemicals from lubricating oil by-products. F. E. Hixon. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 199–208.—With the rapid growth of the chemical industry, chemicals derived from petroleum have become increasingly important, both for direct commercial application and as feedstock for the manufacture of other derivatives. In this field chemicals manufactured from lub oil by-products are of considerable prominence. In this paper the method employed for the recovery and refining of naphthenic acids, petroleum sulphonates, higher olefins and their derivatives from paraffin wax, and aromatic extracts are discussed in general, together with their properties and applications.

(Author's abstract.)

1594. Development in the use of tantalum and zirconium for the petrochemical industry. C. G. van der Wateren. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 111–25.—The main application of tantalum in the petroleum chemical industry is its use as construction material for the bayonet heaters in Mantius concentrators for "black acid." A description is given of the conventional design for these heaters. Some difficulties and failures that have occurred after a few years of operation are analysed. Improved designs for these heaters are described, as well as a new method for lining vessels and tubular equipment with thin tantalum sheet and tantalum tubing. By this latter method a considerable saving in cost of heat exchangers as compared with the conventional design can be achieved. A reboiler for H_2SO_4 designed along these lines is described. Zirconium has only recently become available on the open market. In view of the fact that this metal is much cheaper than tantalum—its price is only *ca* 15% of that of tantalum/unit of vol—it may be predicted that

in the future it will not only replace tantalum in many cases but it will also find a relatively large field of application in the chemical industry. From tests in the lab of the Royal Dutch/Shell Group it appears that, compared with tantalum, welding of zirconium is not so difficult. The principles described for the construction of tantalum equipment also hold good for zirconium, but, owing to its lower price, the design can often be simplified in order to save on costs of fabrication.

(Author's abstract.)

1595. Petrochemicals unlimited. Pt VI. Miscellaneous major chemicals. P. W. Sherwood. *Petrol. Engr*, 1956, **28** (11), C19–25.—The author discusses in some detail the major processes for producing ethanolamines, substituted aromatics, nitriles, and nitro-paraffins. Ethanolamines and substituted aromatic sulphonates form the basis of detergents, while certain nitriles are consumed in synthetic fibre manufacture, *e.g.* Orlon, Acrilan. E. A. G. H.

1596. Chemicals from petroleum in the United States. J. P. Cunningham. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 209–26.—The manufacture of chemicals from raw materials of petroleum origin in the U.S.A. is discussed, with particular attention to the nature and extent of participation by oil companies. Production and sales data are presented to illustrate the position of these companies as suppliers of: (1) hydrocarbons; (2) inorganic chemicals; and (3) synthetic organic chemicals. It is shown that the sale of hydrocarbons by the oil industry for chemical conversion in 1953 resulted in a gross return of *ca* $180,000,000, while the total value of chemicals derived from oil and gas was of the order of $3 billion. In the field of inorganic chemicals, natural gas dominates the synthetic ammonia picture as a source of hydrogen. 5 oil companies participate in the synthesis of ammonia, operating 27% of the national plant capacity, and their combined production has a value of the order of $80,000,000/year. Natural gas is also of great and increasing importance in the production of sulphur and carbon black. The greatest growth and diversification of production is expected in synthetic organic chemicals. The oil industry's foothold in this segment of the chemical industry has been established by 3 companies with an aggregate gross income of *ca* $275,000,000. The chemical activities of these successful companies are characterized by separation and specialization in organization and by emphasis on development and research.

(Author's abstract.)

1597. The Canadian petrochemical industry. A. W. Hutchison and R. G. Stevens. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 155–66.—The rapid growth since 1939 of industries diversifying Canada's economy has given rise to a demand for many petroleum chemicals, justifying the erection of manufacturing facilities. From the inception of the petroleum chemical industry in the early forties, capital investment grew to $230 million by the end of 1953, mainly in 4 centres—Edmonton and Calgary, in Alberta; Sarnia, Ontario; and Montreal, Quebec. The location of plants has been governed partly by nearness to markets, but also by the discovery in recent years of large-scale reserves of oil and natural gas in Alberta and the expansion of oil-refining capacity at these centres. Further development of the industry is expected to be conditioned mainly by that of the economy as a whole. A description is given of the origin, manufacturing operations, and products of the main petroleum chemical plants in Canada.

(Authors' abstract.)

1598. The petrochemical industry in Italy. C. Ballabio. *Proc. Fourth World Petrol. Congr.*, 1955, **4**, 253–9.—The Ferrara factory represents Italy's first outstanding achievement in chemical production from petroleum and natural gas. Construction of the new plants began in 1950, and many are already in operation, while others are under construction or are being planned along lines well abreast of the rapid improvements and developments in this industry. The most important plants already in operation are those for polyethylene (capacity 8000 tons/year); polystyrene (capacity 8000 tons/year), *iso*propyl, butyl, and *iso*butyl alcohol; acetone, dichloroethane, dibromoethane, and ethyl chloride; plasticizers (phthalates) for polyvinyl chloride and terylene. The crude arrives from the port terminal of Porto Marghera (Venice) by waterway. The dist are processed by cracking to produce highly pure ethylene, propylene, and butylene. Natural gas from the Po Valley wells is the raw material for production of ammonia, which is converted into ammonium nitrate and urea. (Author's abstract.)

1599. American Chemical Society. 1. Anon. *Petrol. Times*, 24.5.57, **61** (1560), 450.—Abstracts are given of papers presented at Miami, Florida, April 1957 on nuclear technology in the petroleum and chemical industries. G. A. C.

COAL, SHALE, AND PEAT

1600. Coal extraction. (In German.) C. Kröger. *Erdöl u. Kohle*, 1956, **9**, 441–6.—The present state of knowledge of coal extraction is presented, and theoretical conclusions—developed on the basis of results obtained—are drawn. The extraction process, influence of pre-treatment, of solvent, of carbonization degree, and of temp are discussed. Chem and physical nature of the extracts and the possibility of judging coking behaviour of coals on the basis of extraction results are investigated. 30 refs. R. T.

1601. Carbonization of agglomerating coals in a fluidized bed. E. W. Lang, H. G. Smith, and C. Bordenca. *Industr. Engng Chem.*, 1957, **49**, 355–9.—3 techniques for the prevention of agglomeration in fluidized beds were investigated—pre-oxidn of the coal feed at 600° F, pre-blending of coal with cold char, and internal blending of the feed with hot char. The latter method was the most efficient, the amount of recycle char being 10 times the feed. The yields and properties of the products obtained are discussed. D. B. S.

1602. Oxidation of peat to organic acids. E. L. Piret *et al.* *Industr. Engng Chem.*, 1957, **49**, 737–41.—The lab oxidn of peat by 3 methods was investigated. Alkaline permanganate, used at permanganate: peat wt ratio of 4·0–5·33, converted up to 22% of the carbon present to water-soluble polycarboxylic acids. Nitric acid oxidn produced up to 20% extractable humic acids after 2 hr treatment, whilst air oxidn at 150° C produced a max of 36% humic acids after a treatment of *ca* 5 weeks. D. B. S.

MISCELLANEOUS PRODUCTS

1603. Kinetic studies of petroleum antioxidants. G. W. Kennerly and W. L. Patterson. *Industr. Engng Chem.*, 1956, **48**, 1917–24.—Antioxidant petroleum additives may be conveniently divided into 2 groups—free radical inhibitors and peroxide decomposers. Free radical inhibitors, such as most gasoline antioxidants, should be a compromise between sensitivity to free radical attack and stability against O_2 attack. Since the activation energy for the inhibiting reaction is lower than that for oxidn, a reduction in temp should result in an approach to theoretical efficiency. Peroxide decomposers, which include most of the commonly used lub oil antioxidants, should be used for more severe conditions where high concn of antioxidant are required. Combinations of inhibitors and decomposers show synergistic effects.

D. B. S.

CORROSION

1604. Corrosion testing. (In German.) B. Waeser. *Erdöl u. Kohle*, 1956, **9** (8), 530–4.—Types of corrosion of numerous materials, detection, cause, testing, and prevention—coating, cathodic protection, etc.—are discussed. Instrumentation employed is illustrated. R. T.

1605. Corrosion inhibitors in petroleum processing equipment. R. S. Baxter, H. H. Bennett, and V. W. Hatchett. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 197–211.—The causes of corrosion in petroleum processing equipment and the various methods of mitigating corrosion are discussed, with emphasis on the organic film-forming inhibitors. The theory of the mechanism of protection by organic inhibitors is reviewed. The advantage and economics of using this type of inhibitor are pointed out, and several methods that are utilized in adding the inhibitors are described. The merits of using iron analyses of streams and test coupons are evaluated. Several case histories covering a period of 4 years are cited in which the inhibitors have been used to control corrosion in various types of petroleum refining equipment. The use of inhibitors for certain applications has permitted the use of carbon steel in place of more expensive alloys or other methods of corrosion control, and has reduced the need for neutralizers. The detergent action of the inhibitors has been beneficial. Cost of using the inhibitors has ranged from $0.30 to $1.50/1000 brl of unit charge. The inhibitors have increased equipment life, improved unit operation, shortened down time, and reduced the cost of cleaning and repairs.
(Authors' abstract.)

1606. Preventing corrosion by crude—the use of surface-active agents. D. Bass. *Petroleum, Lond.*, 1957, **20** (4), 139–42.—The utility of cationic surface-active agents for protecting metal surfaces is explained on the basis of a surface adsorbing them to acquire a water repellent character, and in many cases, high germicidal activity. The problem in respect of corrosion by crude is discussed, the best inhibitor being di-coco di-methyl ammonium chloride. Special reference is made to water injection techniques. For refinery equipment the results of inhibitor evaluation tests are disclosed.
E. A. G. H.

1607. Corrosion in distilling and vacuum-distilling plants for the processing of Middle East crude oils. W. A. Derungs. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 49–54.—6 years' operating experience at N. V. Bataafsche Petroleum Maatschappij refineries with Middle East crude oils containing 2–7% by wt of sulphur and aq chlorides which liberate hydrochloric acid at dist temp, has indicated that mild steel can be used extensively in atmospheric and vacuum-dist units, provided that the max operating temp is restricted to 300°–330° C; that 3% by wt of aq caustic soda mixed with cold crude oil is injected into the feed line between heat exchangers and furnace; and that 3% by wt of aq ammonia is injected into the overhead fire. Recommended construction materials are listed for the various parts of the crude oil dist units.
(Author's abstract.)

1608. High-temperature hydrogen-sulphide corrosion in commercial Sovaformer units. E. B. Backensto, R. D. Drew, and J. N. Vlachos. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 55–67.—Corrosion test results obtained in 2 commercial Sovaformers (static-bed reformers utilizing a platinum-type cat) are presented for a wide variety of commonly used steels. These data agree well with data obtained in the lab. Summary curves are presented which relate temp and concn of hydrogen sulphide to corrosion rates for 0–5% chromium steels and for chromium–nickel austenitic steels. These data are also useful for predicting the degree of sulphide scaling possible under commercial conditions. In cases where metal loss is quite low, scaling may still be a serious problem if it leads to equipment plugging which increases operating cost and causes more frequent and prolonged shutdowns. Under these conditions the scaling problem rather than metal loss may dictate the choice of alloys; as an alternative the use of aluminium coatings may be considered. Evidence is shown that aluminizing, especially with a diffused coating, will protect the base metal against scaling attack under conditions found in the hot sections of cat reformers. Evidence is also shown that intergranular microfissuring at the surface of low-chromium steels is possible in commercial reforming units.
(Authors' abstract.)

1609. How Richfield plans to combat high-temperature sulphide corrosion in its new catalytic reformer. B. W. Neumaier and C. M. Schillmoller. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 68–77.—Richfield Oil Corpn is making an all-out effort to avoid the very high corrosion rates and the scaling problems which are being caused by high-temp sulphide attack in cat reforming and associated processes.

Anticipated max corrosion rates have been plotted for different hydrogen-sulphide concn at temp which occur in Richfield Oil Corpn's reformer and hydrodesulphurizer units. Metallurgical selection, which is based on these graphs, is given.

Preparation has been made for a continuous corrosion-control evaluation. The new reformer was expected to be on-stream in June 1956.

The importance of applying corrosion control in the design stage of a unit is stressed. It is far more economical to prevent corrosion before it becomes a problem, by building resistance into a structure, than it is to attempt to stop corrosion after it has taken its partial toll.
(Authors' abstract.)

1610. Stopping sulphur corrosion in a catalytic reformer. B. W. Neumaier and C. M. Schillmoller. *Petrol. Engr*, 1956, **28** (13), C33–9.—This article describes methods of avoiding very high corrosion rates and scaling problems caused by high temp sulphide attack. Anticipated max corrosion rates have been plotted for different hydrogen sulphide concn at temp which occur in reformer and hydrodesulphurizer units. Metallurgical selection was based on these graphs. The importance of applying corrosion control in the design stage of a unit is stressed. E. A. G. H.

1611. The new look in asphalt pipe enamels. L. F. Bramble. *Pipe Line News*, 1957, **29** (3), 43–4.—The merits of asphalt pipe enamel coatings are described. They appear to be superior to coal tar coatings. D. B. S.

1612. Direct current method for locating pipe coating faults. L. F. Heverly. *Pipe Line News*, 1957, **29** (3), 45–7.—A d.c. unit which employs a fixed reference electrode, a vacuum tube voltmeter, and a copper sulphate exploring electrode is described. The buried pipe is intermittently energized with a 2 sec on–off period, and faults are indicated by abrupt changes in millivolt reading as the exploring electrode is moved along the surface. This method has a particular advantage when interference of audio methods by the presence of power lines occurs. D. B. S.

1613. Corrosion of underground pipe in urban areas. R. F. Hadley and D. F. van de Water. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 245–51.—The mitigation of corrosion in urban areas presents problems not encountered in rural areas. The proper use of corrosion control permits decrease in the thickness of pipe wall. Various types of protective coatings are available for use. No evaluation of the coatings

is given, but experience with specific coatings shows there are differences. Cathodic protection should always be used with protective coatings, and may be used for protecting bare pipe. Stray currents present a problem, particularly in urban areas, and can be used to protect underground structures. Co-operation between operators of underground structures is of great importance. (Authors' abstract.)

1614. Locating "hot spots" for cathodic protection. A. G. Prasil. *Pipe Line News*, 1957, **29** (2), 54–5.—The soil resistivity survey and pipe to soil potential survey methods are briefly described. Soils with resistivity values of less than 1000 ohm-cm are almost always corrosive, whilst those above 10,000 ohm-cm are rarely corrosive. D. B. S.

1615. Cathodic protection for pipelines. H. M. Powell and J. H. Morgan. *Petroleum, Lond.*, 1957, **20** (4), 135–8, 142.—This paper aims at establishing a method of accurate mathematical treatment of the costs of cathodic protection installations in relation to the various design factors. General mathematical bases of design are briefly explained, and a hypothetical pipeline of average characteristics is considered as an example. Indications are also given of the effect upon design of such factors as size of individual installation, spacing of installations along the pipeline route, resistance of pipe coating, resistance of pipeline metal, and distance of ground bed from pipeline. E. A. G. H.

1616. A 17-year cathodic protection programme has paid off. G. R. Olson. *Petrol. Engr*, 1956, **28** (13), D35–43.—A history of the inauguration of this programme is recounted, with details of the survey carried out and cost considerations, illustrated graphically. The large-scale programme which commenced in 1941 is described, and mention is made of the annual general maintenance operations.

The cumulated progress of the whole cathodic protection system since 1939 is discussed and forecasts for the future made regarding the bare and badly corroded pipelines laid for 25 years or more. E. A. G. H.

1617. NACE holds record meeting in St Louis. Anon. *Pipe Line News*, 1957, **29** (3), 60–70; **29** (4), 53–65.—Comprehensive abstracts of 29 papers presented at the annual NACE Conference, March 1957. Subjects include corrosion in oil well casings, coal chemical plants, engine cooling systems, underground cables, reinforced concrete and pipelines; inhibition; cathodic protection; preventive coatings; and soil resistivity. D. B. S.

SAFETY PRECAUTIONS

1618. The oil companies—what are they doing? Anon. *API Quart.*, Winter 1956–57, 28–9.—A review of the efforts of the oil companies—by means of relevant literature and films—to instil safe-driving habits into motorists. R. T.

1619. API accentuates the positive. Anon. *API Quart.*, Winter 1956–57, 24–7.—The serious accident position has led President Eisenhower to take a personal interest. The approach to the problem by various bodies is discussed. The work of API's Central Committee on Accident Prevention within the industry has paved the way for the efforts of the American Petroleum Industries Committee on a vastly wider scale. The campaign—not entirely satisfactory—resulted in co-ordination of the efforts of the 2 committees. R. T.

1620. Safety symposium. Various. *Pipe Line News*, 1957, **29** (3), 48–50.—2 papers in which the precautions to be taken when carrying out maintenance on natural gas and oil pipelines are described. D. B. S.

1621. Aqueous foams. Various. *Industr. Engng Chem.*, 1956, **48**, 2013–51.—8 papers. Subjects of interest to the petroleum industry include: foam for industrial fire protection; foam as a fire exposure protection medium; characterization of foams for foam extinguishment; and research studies in foam generating equipment. D. B. S.

MISCELLANEOUS

1622. Techniques of forecasting oil demand. H. E. Barry. *Inst. Petrol. Rev.*, 1957, **11** (125), 119.—This is a paper read at a meeting of the IP Economics and Operations Group, Nov 1956. Total consumption, trends in end uses, and estimating by association methods are considered for long- or medium-term estimates. Short-term estimates demand high accuracy, and a common method is to derive the seasonal pattern from a moving average. It is also shown that the incidence of Easter weekend and Bank Holiday is of importance in forecasting. G. A. C.

1623. International trade and international peace. L. B. Pearson. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 18–21.—The economic and political aspects of the Canadian oil and gas industry are discussed in the light of national development and the effects of foreign participation and are related to the worldwide economic situation, especially the challenge of competitive co-existence. No one individual, corporation, or nation can carry the burden of international co-operation alone—this responsibility is best discharged through acts of goodwill and friendship, such as exist between Canada and the U.S.A. (Author's abstract.)

1624. Making up for Suez. C. E. Davis. *API Quart.*, Winter 1956–57, 10–12.—The closing of the Suez Canal—now ended—showed—by daily production and transportation figures—the dependence of W. Europe on its "Ditch." Middle East production, crude disposition, and estimated crude and product movements for 1956 are tabulated. R. T.

1625. Size was only half the story. Anon. *API Quart.*, Winter 1956–57, 4–7.—API's 36th Annual Meeting in Chicago urges oil men to seek passage of natural gas legislation in Congress's next Session. The public—aware of the industry's great material contributions to the comfort and well-being of the American people—must be convinced that the oil industry has its interest at heart. This is OIC's task for 1957. The attack on the percentage depletion provision must be resisted. There appears to be no danger of oil shortage in the U.S.A. in the foreseeable future. Domestic crude production could be maintained at more than 2,000,000 b.d. for 3 years or more. Thus, present requirements could be met in any eventuality. The federal highway programme is badly needed to combat the "creeping paralysis" caused by inadequate highways. R. T.

1626. The other side of freedom: responsibility. B. Jennings. *API Quart.*, Winter 1956–57, 21–3.—The public attitude towards big business—fostered by propaganda—is discussed. Public fear may be a healthy, necessary condition of

democracy in controlling power concn in any organization, group, government unit, or individual. Business men should talk less about freedom, more about responsibility. The term "free enterprise" as used could be replaced by "responsible enterprise." Private enterprise suggests exclusiveness and secrecy. R. T.

1627. Developing engineers in the field of refining technology. D. S. Simmons. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 355–8.—Since 1941 Imperial Oil Ltd has given, at Sarnia, Ontario, intensive 9-week refining technology courses to 100 refinery engineers from across Canada. The refinery engineering staffs had remained static during the second world war, and at the end of the war the refineries were old, and petroleum engineering data, including the engineering *Blue Book*, were secret material. These facts prompted recognition of the need for training. The aims of the course, which is extensively revised each time it is offered, include integration of the refinery and the Engineering Division and helps to raise the refinery engineer's sights beyond the technical routine. (Author's abstract.)

1628. Liberal education for business leadership. J. R. Kidd. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 359–64.—No longer is technical education the sole qualification for business leadership. An understanding of human values and the common sense bred of self-confidence are equally important, if not more so. An indispensable background for the executive is a liberal arts education which is continued throughout life; not limited to a small privileged class; with a relevant curriculum presented by suitable methods, and providing a place for both science and the arts. It is these principles which alone can produce the character capable of using technology as a means to the good life, rather than as an end in itself. (Author's abstract.)

1629. The line manager's role in supervisory development. C. Davidson and S. D. Rees. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 365–71.—In the evolution of adequate training methods in a refinery the authors show certain disadvantages of a programme, which was, in the main, the responsibility of a training supervisor and in which group composition was not stressed. Nevertheless, this programme made its positive contributions to training and, indeed, is looked upon as something the authors were glad to have gone through as a transitionary stage to later improvements. Such improvements emanated from the reformation of supervisory personnel into groups whose members had common job interests, who talked the same language, and whose training could proceed through consideration of matters realistically connected with job requirements as determined by them and developed by the appropriate line manager. This has resulted in increased member participation, both in conference and on the job, identification of the line manager with training responsibilities and, concurrently, the most desirable development of the latter in the management skills he should have to fill the higher managerial positions of to-morrow. (Authors' abstract.)

1630. Review of fundamentals of chemical engineering. Various. *Industr. Engng Chem.*, 1957, **49**, 538–626.—Reviews of interest to the petroleum industry are briefly abstracted below. References are numerous.

Computers, mathematics, statistics, and automation. The use of computers for optimizing process operations has received particular attention. The value of servo-mechanism theory and computer simulation in solving automatic control problems has also been recognized.

Mass transfer. General correlations for the quantitative estimation of plate efficiencies can be anticipated soon.

Thermodynamics. A large number of papers on p–v–t relationships and phase equilibria have appeared, but no outstanding developments have been made in terms of new concepts for better experimental or computational methods.

Chemisorption and surface catalysis. Kinetic studies of hydrocarbon cracking on various cat have thrown more light on the fundamentals of cat behaviour.

Other reviews. Colloids and surface behaviour; heat transfer; fluid dynamics; mol transport properties of fluids; diffusion and oxidn of metals. D. B. S.

1631. Annual review of unit operations. Various. *Industr. Engng Chem.*, 1957, **49**, 457–537.—References are numerous. Reviews of particular petroleum interest are:

Adsorption and humidification. Information has been published on the pressure drop, hold-up, entrainment, loading and flooding characteristics, etc., of Spraypak, Stedman packing, and Raschig rings.

Adsorption. Adsorption in fluidized beds has received some attention.

Flow of fluids. Some methods for predicting visc of non-Newtonian fluids have been suggested, but general information is still inadequate. Problems of flow distribution, interphase contacting, and mass transfer within fluidized beds have been investigated. The hydraulic transportation of solids by pipelines is receiving attention.

High temperature distillation. Several new tray designs have appeared, the rotating core or brush still used as a thermal dist unit being the most promising. Data on the performance of bubble-cap, sieve, and grid trays have been published. Several methods for calculating vapour–liq equilibrium data for hydrocarbons have been suggested.

Liquid extraction. There have been no major extraction developments in petroleum refining, although the Udex process for separating aromatics from hydrocarbon mixtures has been expanded to the new Rexforming process. New processes for the refining of lub oils, desulphurization, and the removal of aromatics have been suggested. Several types of contacting device have been studied, including spray, packed, rotating-disk, agitated, pulsed, and centrifugal extraction columns. Podbielniak centrifugal extractors are finding applications in petroleum refining.

Other reviews. Crystallization, drying, evaporation, filtration, flotation, ion exchange, materials handling, mixing, and size reduction. D. B. S.

1632. The use of aluminium in the petroleum industry. T. J. Peake. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 127–49.—Information is given on the special characteristics of aluminium that are of value to the petroleum industry. These are dealt with under the headings chemical, physical, and mechanical properties, and weldability. The use of aluminium in a number of different applications in the oilfield, refinery, and in the distribution and marketing of refined oil products is described. The applications covered are building products, roofs for oil storage tanks, pipelines, sheathing for insulation, instrument air tubing, condensers and heat exchangers, cat, heating coils for tankers, containers for the marketing of petroleum lubricants, drums, anodes for cathodic protection, and paint. (Author's abstract.)

1633. Steel and refractory alloys. P. Villain. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 61–79.—Having endeavoured to set forth a definition of what may be termed refractory steel, the author examines the principal properties thereof and goes more thoroughly into the following items: corrosion by hot air or gaseous atmospheres—thermal equilibrium; creep—actual stress which the different alloys can bear at different temp; stability—changes occurring in the structure of the metal after being kept at high temp for a considerable time; moulding, forging, and rolling properties—pipe production and centrifugation; welding properties; abrasion-proof refractory alloys; resistance to sulphur and its cpds, resistance to effect of carbon. Finally, the most widely used

refractory steels are reviewed and some new applications mentioned. The conclusion states that present research on steels for turbojets construction will lead to further improvements in the properties of already known and widely used refractory materials. (Author's abstract.)

1634. Alloy and special steels for the petroleum industry. G. R. Bolsover and J. F. Sewell. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 49–60.—The paper consists of a brief review of recent developments in the general field of steels which can be of service in the production and usage sides of the oil industry. General attention is devoted to stainless and heat-resisting steels, the former including information on properties at low temp, electrochemical methods of polishing, and comparisons between low carbon and stabilized steels on resistance to weld decay and the latest data on recent developments for bolts for service at high temp. Reference is also made to possible economies in alloy usage in low alloy steels in view of the recurrent shortages, and also to the possibilities of a weldable steel with a high value yield point.
(Authors' abstract.)

1635. The brittleness of steel caused by hydrogen. P. Bastien and P. Amiot. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 151–69.—After a brief introduction tracing the history of phenomena of brittleness caused by hydrogen, some general ideas are submitted on this subject. The following points are then discussed: the characteristics of typical cases of brittleness; surroundings in which brittleness is likely to develop; the influence of the metal's intrinsic characteristics; the influence of the kind of mechanical stress.
(Authors' abstract.)

1636. In which cases should an 18/8-steel with 0·03% C or 0·05% C or a stabilized steel be chosen? G. Lilljekvist and S. Hansen. *Proc. Fourth World Petrol. Congr.*, 1955, **7**, 171–8.—This article is a contribution to the discussion regarding the influence of the carbon content on the properties and use of stainless austenitic 18/8-steels as well as the influence of stabilizing alloy elements. It also presents results from research work made by Avesta Jernverks Aktiebolag, Avesta, Sweden. In most cases where the use of stainless 18/8-steels is convenient in chemical industry, the application of 18/8-steels with a carbon content of max 0·05% can be used in thickness up to approx 20 mm for welded vessels without subsequent heat treatment. Over this thickness steels with a carbon content of max 0·3% or stabilized grades should be used. (Authors' abstract.)

1637. Floor wax slip testing. B. Berkeley and J. D. Burns. *Soap, N.Y.*, 1957, **33** (4), 77.—An investigation into the use of the Dura Slip Resistance Tests has shown the equipment suitable for measuring static coeff of friction in the range 0·088–1·000. The results were within acceptable limits, and compared favourably with those by the James Machine or Underwriter's type slip tester. The machine is described and operating conditions given. G. A. C.

1638. Properties of different mineral waxes and their preliminary stages. (In German.) H. Lindemann. *Erdöl u. Kohle*, 1956, **9**, 458–9.—Use of the term wax and widespread applications of waxes are discussed. Production, constitution, analysis, and physical properties are described. R. T.

1639. Aerosol containers. C. A. Southby. *Petroleum, Lond.*, 1957, **20** (5), 181–2.—The author outlines the history of the aerosol package, its applications, and possibilities for the future in more extensive use of the container. The basic design of surface and space spray containers is described, together with their utility in respect of oils and petroleum chemical products. E. A. G. H.

1640. The diatometer—a method for indicating the conditions of aquatic life. R. Patrick and M. H. Hohn. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 332–9.—The results of numerous river surveys have shown that diatoms are one of the most reliable groups for indicating river conditions. They are also very easy to collect and process for study.

As a result of considerable research it was found that the structure of a natural population corresponded to a truncated normal curve. The effects of pollution were to lengthen or put a " tail " on the curve, lower the height of the mode, and reduce the number of species in the total population.

The first research work was done on rivers. The work done, under a grant from the API, on the Atlantic and Gulf Coasts shows that the shape of the curve in natural waters and the effect of pollution on the shape of the curve is, in general, the same in bays, estuaries, and ship channels as it is in rivers. The main differences lie in the fact that the height of the mode is between 19 and 22 species rather than 20 and 26 species as found in rivers. Likewise the number of species in the total population is a little less. (Authors' abstract.)

1641. Oil legislation in Turkey. T. H. H. Skeet. *Petroleum, Lond.*, 1957, **20** (5), 176–80.—Extensive exploration is taking place in Turkey, and in this paper developments since 1931 are reviewed with particular reference to the legal position, including the implications of existing legislation to the oil companies. An oil concessions map of Turkey is included, showing in some areas the holdings of individual companies.
E. A. G. H.

BOOK REVIEWS

Analysis For Production Management. E. H. Bowman and R. B. Fetter. Homewood, Illinois: Richard D. Irwin, Inc., 1957. $6.50.

As the authors state in the preface of their book, " Useful developments in the field of analysis of industrial operations have recently far outstripped text books designed for students of industrial management, administration, and for engineering." It is apparent that the authors have filled this need in introducing operational research methods. Excellent elementary introductions to operational research methodology, clearly illustrated by simple examples, employing only very simple mathematics, is given throughout the book. This approach should give the reader a clear understanding of how the methods work and the type of problems to which they are applicable, but it is doubtful, except in simple cases, whether the reader will be able to solve real examples.

The book sets out to explain the newer useful developments of analysis of industrial operations and not to teach the readers how to do them. The references at the end of each chapter indicate where the reader can obtain more aid, if he wishes to carry out these analyses himself. The reader should be better able to interpret the results from an analysis team.

From the petroleum industry viewpoint it is unfortunate that most examples are from the engineering production field. A similar approach, employing examples from the petroleum industry, would make this book an excellent introduction to operation research analysis for management.

The book is divided into four sections:—

(1) *Orientation*, which gives a brief background into the history and growth of management, especially analytical methods in management, introducing work study methods, hypothesis, and model building.

(2) *Mathematical Programming*, introducing linear programming and transportation theory.

(3) *Statistical Analysis*, introducing quality control, specifications, sampling plans, acceptance testing, and finally leading to analysis of variance and factorial experimentation.

(4) *Economic Problems*, introducing probability models, and hence inventory control, queue theory, Monte Carlo methods. In this section an introduction to equipment investment analysis is given.

Some ten case studies are given which are class examples to be analysed by students under the direction of an instructor. A reader who wishes only to understand the methodology may neglect these.

A similar book, illustrated by examples from the petroleum industry and including worked case studies, would be a valuable introduction to many technicians and managers in this industry. R. J. D.

Plant and Process Dynamic Characteristics. London: Butterworths Scientific Publications, 1957. Pp. xii + 246. 50*s*.

This volume represents the Proceedings of a Conference held in April 1956 by The Society of Instrument Technology. It contains 11 papers and the discussions on them. The field that might be covered by the title is a very wide one. The papers presented here do not constitute a systematic survey of the whole field, but are "weighted in the direction of chemical engineering." Some of the subjects discussed are of particular relevance to the petroleum industry. One such example is the dynamic characteristics of a natural-circulation reboiler. Another one is the effect of changes in feed composition on the compositions of the liquids on the plates of a fractionating column. The papers are of high quality, and they represent a considerable amount of both theoretical and experimental work. The book is essentially intended for—and should be of value to —specialists in the field of process control. A. J. V. U.

The Reduction and Presentation of Experimental Results. J. T. Richardson. BS 2846 : 1957. London: British Standards Institution, 1957. Pp. 44. 10*s*. net.

The expression of experimental results is an art which calls for more and more skill, and J. T. Richardson, a member of the scientific staff of ICI Ltd, has done a considerable service in developing the theme of uniformity of procedure in summarizing and comparing results in any field of scientific and technical investigation.

The coverage of the subject is wide, and of particular interest is the chapter on frequency distribution. The "arithmetic mean" and "standard deviation" quantities are evaluated, and "confidence limits" are also discussed.

A useful glossary is given, and the book should be of value to students and to experienced workers.

Application of Gas–Liquid Chromatography to Hydrocarbon Analysis. R. P. W. Scott. Benzole Producers Ltd Research Paper 4–1957. London: Benzole Producers Ltd, 1957. Pp. 68.

After describing the technique of gas–liquid chromatography in general terms, various types of detectors and apparatus are discussed. Experimental techniques and equipment are dealt with, and the factors affecting column efficiency are considered. The conditions for obtaining optimum efficiency from a 5-ft partition column are listed.

Retention Ratios for Hydrocarbons. R. P. W. Scott. Benzole Producers Ltd Research Paper 8–1957. London: Benzole Producers Ltd, 1957. Pp. 7.

This companion paper to Research Paper 4–1957 gives ratio data obtained in the laboratories of Benzole Producers Ltd.

The Disposal of Acid Tar. K. H. V. French. Benzole Producers Ltd Research Paper 6–1957. London: Benzole Producers Ltd, 1957. Pp. 4.

A description of processes used or examined for the disposal of acid tar by the North Thames Gas Board, the South Eastern Gas Board, and the Midland Tar Distillers Ltd.

Symposium on Corona (ASTM Special Technical Publication 198). Philadelphia, Pa; American Society for Testing Materials, 1957. Pp. 32. $1.25.

The deleterious effects of corona on organic electrical insulation have been known for years. The considerable research and investigational work has been largely of an independent nature, with the result that no common or standard methods of corona detection and evaluation of the corona resistance of insulating materials have appeared in the literature.

Committee D-9 on Electrical Insulating Materials initiated research and standardization of methods for corona detection and material evaluation in this field. An accomplishment was this Symposium. Papers included are:

Preliminary Corona Resistance Test Results from IEC Activities—C. W. Ross.

Effects of Corona on Thermosetting Plastic Laminates —A. Rufolo and R. R. Winans.

Corona Resistance Test Method for Laminates, Moulded and Cast Materials—W. T. Starr.

Preliminary Investigation of Proposed Pulse Method for Measuring Ionization—F. S. Oliver, E. H. Povey, and T. A. Pinkham.

Corona Detection and Measurement at Sixty Cycles—J. R. Nye.

Test Methods for Measuring Energy in a Gas Discharge —S. I. Reynolds.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren " Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the " Library Catalogue " published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

000 TULSA PUBLIC LIBRARY. Oil shale and shale oil. Tulsa, Okla., Public Library, 1957. 65 p. (Petroleum bibliography no. 38.)

020 IMPERIAL COLLEGE. Inaugural lectures 1955–1956. London, Imperial College, 1957.

020 MARCET-RIBA, J. El IV Congreso Mundial del Petroleo y la participacion Española, Roma, 1955. Barcelona, Iberica, 1956. 20 p.

020 WORLD PETROLEUM CONGRESS. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings. Section 7. Construction of equipment. Rome, Carlo Colombo (1956). 290 p.

020 WORLD PETROLEUM CONGRESS. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings. Section 8. Transport, storage, distribution. Rome, Carlo Colombo (1956). 170 p.

020 WORLD PETROLEUM CONGRESS. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings. Section 9. Economics, statistics, education. Rome, Carlo Colombo (1956). 165 p.

030 NEW SOUTH WALES. *Department of Mines.* Technical reports. Vol. 1. 1953. Sydney, Dept. Mines, 1956. 82 p.

030 NEW SOUTH WALES. *Department of Mines.* Technical reports. Vol. 2. 1954. Sydney, Dept. Mines, 1957. 77 p.

090 BRITISH ENGINE BOILER AND ELECTRICAL INSURANCE CO. LTD. Technical report. Vol. 3. Manchester, British Engine . . ., 1957. 222 p.

090 BRITISH STANDARDS INSTITUTION. Bitumen-base filling compounds for electrical purposes. London, BSI, 1957. 50 p. (BS 1858 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Determination of closed flash-point of petroleum products by means of the Pensky–Martens apparatus. London, BSI, 1957. 12 p. (BS 2839 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Filter flasks. London, BSI, 1957. 10 p. (BS 1739 : 1957.)

090 BRITISH STANDARDS INSTITUTION. General purpose Acme screw threads. London, BSI, 1957. 44 p. (BS 1104 : 1957.)

090 BRITISH STANDARDS INSTITUTION. General purpose maximum and minimum thermometers (Six's pattern). London, BSI, 1957. 7 p. (BS 2840 : 1957.)

090 BRITISH STANDARDS INSTITUTION. General purpose wet and dry bulb hygrometer. London, BSI, 1957. 7 p. (BS 2841 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Measurement of air flow for compressors and exhausters. London, BSI, 1957. 30 p. (BS 726 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Rapid method combustion tubes (Belcher and Ingram type): microchemical apparatus: Group A: combustion trains for the determination of elements. London, BSI, 1957. 9 p. (BS 1428 : Part A5 : 1957.)

090 BRITISH STANDARDS INSTITUTION. The reduction and presentation of experimental results, by J. T. Richardson. London, BSI, 1957. 43 p. (BS 2846 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Solid drawn copper alloy tubes for heat exchange equipment in the petroleum industry. London, BSI, 1957. 24 p. (BS 1464 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Tests for industrial crawler and wheeled tractors (excluding units designed for materials handling in factories). London, BSI, 1957. 22 p. (BS 2800 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Whirling hygrometer (medium size). London, BSI, 1957. 9 p. (BS 2842 : 1957.)

090 DAVIES, O. L., *ed.* The design and analysis of industrial experiments. 2nd ed. London, Oliver and Boyd for ICI, 1956. 649 p.

111 UNITED STATES. BUREAU OF MINES. Oil yields of sections of Green River oil shale in Colorado, 1952–54, by K. E. Stanfield, C. K. Rose, W. S. McAuley, and W. J. Tesch, Jr. Washington, D.C., U.S. Dept. Interior, 1957. 137 p. (Report of investigations 5321.)

137 WARMAN, H. R., *and others.* Report on oil and gas in the United Kingdom, by H. R. Warman, K. H. Roberts, R. G. W. Brunstrom, and C. M. Adcock. Mexico, Congreso Geological Internacional, 1956. 38 p. Paper presented at the 20th Congreso Geologico Internacional, Symposium Sobre Yacimientos de Petroleo y Gas, part 5—Europa.

140 THE MIDDLE EAST. The Middle East 1957: a survey and directory of Arabia, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, the Lebanon, Libya, the Sudan, Syria, and Turkey, with geographical, historical, economic, and educational surveys, concise information about political, industrial, financial, and cultural organizations, and Who's Who in the Middle East. 5th ed. London, Europa Publications, 1957. 458 p.

143 BRITISH PETROLEUM CO. LTD. Oil and gas in Southwest Iran. Mexico, Congreso Geologico Internacional, 1956. 40 p. Paper presented at the 20th Congreso Geologico Internacional, Symposium Sobre Yacimientos de Petroleo y Gas, part 2—Asia y Oceania.

210 UNITED STATES. BUREAU OF MINES. A convenient table for determining metastable transitions in mass spectra, by R. A. Meyer and D. G. Earnshaw. Washington, D.C., U.S. Dept. Interior, 1957. 3 p. + tabs. (Report of investigations 5329.)

220 BENZOLE PRODUCERS LTD. Application of gas–liquid chromatography to hydrocarbon analysis, by R. P. W. Scott. London, Benzole Producers, 1957. 68 p. (Research paper 4–1957.)

220 BENZOLE PRODUCERS LTD. Retention ratios for hydrocarbons, by R. P. W. Scott. London, Benzole Producers, 1957. 8 p. (Research paper 8–1957.)

220 COAL TAR RESEARCH ASSOCIATION. Gas chromatography—a bibliography. Gomersal, Coal Tar Research Assoc., 1956. 8 p. (Technical note no. 14.)

260 MONSANTO CHEMICALS LTD. The Petter W.1 test for the evaluation of lubricating oils. London, Monsanto, 1957? 47 p.

340 ALBERTA RESEARCH COUNCIL. Bulk densities, porosities, and liquid saturations of good grade Athabasca sands, by K. A. Clark. Edmonton, Research Council, 1957. 22 p. (Mimeographed circular no. 22.)

340 LOEWINSON-LESSING, F. Y. A historical survey of petrology, by F. Y. Loewinson-Lessing, translated from the Russian by S. I. Romkeieff. London, Oliver and Boyd, 1954. 122 p.

530 UNITED STATES. BUREAU OF MINES. Petroleum-engineering study of gas injection in fault blocks VB and VI, Wilmington Field, California, by R. V. Higgins and R. L. Pierce. Washington, D.C., U.S. Dept. Interior, 1957. 20 p. (Report of investigations 5338.)

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1642. Implications of gentle Ordovician folding in Western Virginia. W. D. Lawry. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 643–55.—Much remains to be learned about the depositional and deformational history of the S. Appalachians. A major step toward a better understanding of the geologic history of Virginia would be the reliable assignment of definite ages to the lower Palæozoic metasedimentary rocks of the Piedmont.

Abnormally great thicknesses of Palæozoic sediments in the Massanutten and Greendale synclines in W. Virginia indicate that gentle folding accompanied sedimentation. This folding was under way in Ordovician time. The major disconformity between Lower and Middle Ordovician limestones in the Valley-and-Ridge Province is locally absent. An example is the conformable and apparently gradational relationship of these limestones near the depression of a major syncline in the Shenandoah Valley, where the basal Middle Ordovician limestone is abnormally thick. This is of particular significance because on the crest of an adjacent anticline the contact is sharp and the basal Middle Ordovician limestone is very much thinner. E. N. T.

1643. Miogypsinids, planktonic foraminifera, and Gulf Coast Oligocene–Miocene correlations. W. H. Akers and C. W. Drooger. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 656–78.—Comparison and correlation of the Oligocene–Miocene beds of the W. and central Gulf Coast with the much thinner Tertiary section of Florida has long been a challenge to Gulf Coast stratigraphers, and hardly a writer on this subject has failed to emphasize the need for further information, the present writers not excepted.

The foraminiferal family, *Miogypsinidae*, contains evolutionary series, the successive units (species) of which are common to the Louisiana Gulf Coast, Florida, the Caribbean region, and the Mediterranean region. It is suggested that the miogypsinids had a monophyletic origin and that dispersal of some of the evolving groups during the Oligocene and the Miocene was a rapid process. Stratigraphic relationships between miogypsinid species and planktonic foraminifera in the Gulf Coast offer the key to worldwide correlations and proper use of some of the European terminology.

It is apparent that this new faunal evidence affords a better understanding of time relationships within the Gulf Coast, which can be extended to areas of tropical America. These fossils indicate that Suwannee limestone which is exposed at numerous Florida localities, and fossiliferous carbonate rocks to which the name has also been applied in various Florida wells, should be correlated in part with the Chickasawhay formation of Mississippi and in part with the subsurface Anahuac formation and the lower Fleming of Texas and Louisiana. The Tampa limestone of Florida is correlated with the lower middle Fleming. Some of the faunal zones of the Gulf Coast subsurface, such as the well-known Heterostegina zone, are considered to be time-transgressive units.
E. N. T.

1644. Dust-storm sediments of Lubbock area, Texas. K. E. Laprade. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 709–26.—Dust storms are a common phenomenon on the Llano Estacado. The area is especially susceptible to blowing dust because of its low topographic relief, scanty vegetal covering, light-textured topsoils, and recurring strong and turbulent winds. Following periods of prolonged drought, the vegetal covering and moisture content of the soil are reduced, producing conditions favourable for mass movement of sediments by the wind.

This study is an analysis of sediments moved by the wind during dust storms. The grain characteristics were analysed with respect to size, corrosive effects, and mineral composition, and these data were considered in relation to the speed and direction of the wind, the type and duration of the individual storm. Dust samples were collected at Lubbock, Texas, during storms that occurred between 19 Nov 1950 and 26 April 1951. E. N. T.

1645. Midland basin looks to stratigraphic traps. W. J. Thompson. *Oil Gas J.*, 13.5.57, **55** (19), 211.—Both structural and stratigraphic traps have been found in the Midland basin of W. Texas, but fewer important structural traps are now being discovered, and many of the more recent discoveries have been from anomalies of low relief with single pays or structures of limited extent. The geology of the basin is described in detail, with structural and stratigraphic maps, and it is shown that late Palæozoic sedimentary environments have provided a variety of conditions favouring stratigraphical trapping. The most favourable areas are in the Horseshoe atoll region and reefal developments and facies changes around the rim of the basin. C. A. F.

1646. Ecology of Recent foraminifera in Northern Florida Keys. W. E. Moore. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 727–41.—This preliminary ecologic study of foraminifera in the Florida Keys area is based on grab and dredge samples. An outline is given of the foraminiferal environments of the N. Florida Keys area. The foraminiferal data are presented in terms of the relative abundance and distribution of the families present. The ecologic ranges of several of the more important species and genera are indicated. E. N. T.

1647. Eastern Arkansas stirring. F. J. Gardner. *Oil Gas J.*, 13.5.57, **55** (19), 209.—There is renewed interest in the oil possibilities of E. Arkansas in the Desha basin area, which forms the deepest part of the Arkansas syncline. Formations range from Tertiary down to Palæozoic, but they are masked by the Quaternary of the Mississippi valley, and subsurface conditions are obscure. Deep wells have been drilled in the area at intervals, and some have had shows. C. A. F.

1648. Where does Oklahoma get her oil? F. E. McGonagill. *Oil Gas J.*, 6.5.57, **55** (18), 179.—Statistical data on the oil pays of Oklahoma are presented. Tables show the relative importance of 22 main pays, of which the most important (for production) is the Ordovician Wilcox, and also the recovery, number of fields, wells, thickness, oil gravity, proven acreage, and year of discovery for each of the 22 pays.
C. A. F.

1649. Trenton structure in Ohio, Indiana, and Northern Illinois. D. A. Green. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 627–42.—This paper presents concepts of Trenton structure and of geologic history in Ohio, Indiana, and Illinois that are not commonly found in the literature. The literature is reviewed in order to show the origin of structural thought patterns, some of which have been preserved by repetition without any re-examination. This review shows great need for better understanding and for more careful use of structural terminology.

The Cincinnati arch geologic province includes all the structure that separates the Appalachian, Michigan, and Illinois basins.

The major structural features in this province are: Cincinnati arch, Findlay arch, Francesville arch, and Indiana–Ohio platform. The 3 arches lose their identity in the platform, which covers an area of 10,000 sq. miles in which there is no arched structure. N. Illinois is in the Wisconsin arch geologic

province, which had a different geologic history. The Oglesby fault is shown where the LaSalle anticline was first described. The upthrown block between this fault and the Sandwich fault is here shown as the Ottawa horst. Data for the interpretation of the Tuscola fault were supplemented by carefully located core-drill holes in 3 counties. E. N. T.

1650. Heart Mountain and South Fork detachment thrusts of Wyoming. W. G. Pierce. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 591–626.—In broad outline, the Heart Mountain fault of Wyoming is a nearly horizontal thrust whose overriding sheet was derived from a source without any known roots, and whose frontal part has ridden across a former land surface. The suggestion is here made that this thrust and the nearby South Fork thrust are detachment thrusts or decollements, *i.e.* they are sheets of sedimentary rocks which have broken loose along a basal shearing plane, have moved long distances probably by gravitational gliding, and have been deformed independently from the rocks below the fault plane.

In the NW. part of its known extent the Heart Mountain thrust plane follows the bedding of the rocks and lies at the base of the massive and resistant Bighorn dolomite and above the underlying Grove Creek formation (a thin unit at the top of the Cambrian sequence). Near the centre of the area here described this bedding thrust plane changes abruptly to a shear plane that cuts stratigraphically upward across the Bighorn and younger formations; the thrust plane then passes SE. on to and across a former land surface. The present thrust remnants on this surface are separated blocks that rest on rocks ranging in age from Palæozoic to Tertiary.

The concept is advanced that, near the close of early Eocene time, the Heart Mountain thrust originated as a detachment or shearing-off of strata at the base of the Bighorn dolomite. Near Dead Indian Hill the advancing SE. edge of this bedding thrust sheet passed upward into a shear thrust and thence SE. on to and across the land surface as an erosion thrust. E. N. T.

1651. Lower Cretaceous Barranquin formation of Northeastern Venezuela. E. von der Osten. *Bull. Amer. Ass. Petrol. Geol.*, 1957, **41** (4), 679–708.—The Lower Cretaceous Barranquin formation occurs over a large area of NE. Venezuela, including the oldest sedimentary rocks known in that part of the country. Good exposures of the formation on the islands of the Bahia de Santa Fe region permitted a more detailed stratigraphic study than has been possible hitherto, and this paper describes the stratigraphy more fully and presents new conclusions about the age and correlation of the formation which were reached as a result of the study of the collected material. E. N. T.

1652. Brazil confirms Amazon pay. Anon. *Oil Gas J.*, 6.5.57, **55** (18), 94.—Nova Olinda 2-A, drilled on Ilha Maraca, an island in the Rio Madeira in the Amazon basin, on test produced very light oil under high pressure from a 20-ft sand at *ca* 9000 ft. It is estimated that production in Brazil in 1957 will average over 27,500 b.d., compared with *ca* 11,000 b.d. in 1956. Production comes from the old-established Reconcavo fields in Bahia. C. A. F.

1653. Philippines hunt picking up steam. Anon. *Oil Gas J.*, 6.5.57, **55** (18), 97.—A well is being drilled in the Cagayan Valley in N. Luzon, and another is planned. 1 Tumauini, drilled in 1956, was abandoned at 10,414 ft after finding non-commercial oil and gas shows. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1654. Can oil be found by direct methods? F. W. Lee. *Oil Gas J.*, 1.4.57, **55** (13), 109.—Hitherto no direct effect of a buried oil or gas accumulation has been measurable at the ground surface, but it has been known for some time that oil- and gas-bearing sands in contact with shales carry relatively large negative potentials. Use is made of this potential in a surveying technique described as a Sandex survey, which gives information on the location and extent of the impregnated parts of a sand penetrated by a well. A non-polarizing potential electrode is lowered to the depth of the sand to be tested, and additional electrodes are placed on the surface of the ground in a prescribed layout. Current is then passed between selected pairs of the surface electrodes, and appropriate changes of potential between other surface electrodes and the well electrode are measured.

A series of diagrams show the applications of the method and examples. C. A. F.

1655. Detecting subsurface faults by radioactive measurements. W. J. Williams and P. J. Lorenz. *World Oil*, 1957, **144** (5), 126.—Recent studies have shown that surface γ-ray surveys with highly sensitive equipment reveal the presence of faults at the surface or in the subsurface by an increase in activity over the faults, compared with a random background activity away from them, and it is suggested that much of the surface radiation is due to upward migration of radioactive gases through porous beds.

The radiation characteristics of fault zones and other structures are discussed, and examples of γ-ray profiles across faults show that there is a plateau feature in the profile characteristic of the downthrown side of the fault. Only large ionization chambers have proved satisfactory, and these have enabled a continuous record of radiation variations at a travel speed of 20–40 m.p.h. The sources of radiation at the surface, and the factors affecting the radiation profile, are briefly noted. C. A. F.

1656. Use of gravity meter as a torsion balance. V. G. Gabriel. *World Oil*, 1957, **144** (5), 146.—The use of variations in density in oil prospecting is briefly described, and the mathematical basis of the use of the gravimeter as a torsion balance is given in detail, with a method of transforming gravimetric data into rates of change of gravity vectors. A least square technique is briefly described for adjustment of derived vectors. 9 refs. C. A. F.

1657. Reconnaissance and evaluation of formations by electrical and nuclear diagraphy. I. G. Chombart. *Rev. Inst. franç. Pétrole*, 1956, **11** (10), 1193–231.—Among the aims of electrical and nuclear diagraphy are measurements of porosity, water saturation, water resistivity, permeability, and the amount of oil recoverable by "water-drive." The first 3 can be obtained with moderate certainty by current techniques. Resistivity and induced radioactivity measurements may give porosities, resistivity measurements saturations, and SP measurements salinities.

Electrical conduction is more complex in a clayey formation than in a clean one. The configuration of the electroyte-containing pores affects the resistivity for clean, intergranular porosity in water-wet rocks in the porosity range 5–40%, and with at least 10% water saturation the relationship $R_t = \frac{R_w}{\phi^m S_w^n}$ was found to hold, ϕ being the fractional porosity and S_w the fractional water saturation. m ranges 1·3–3·0, depending on cementation, while n depends on pore form, wettability, nature, and mode of introduction of the fluids. The formation resistivity factor is $F = \frac{R_o}{R_w} = \frac{1}{\phi^m}$, R_o being the resistivity of the water-saturated rock. Also $R_t = \frac{R_o}{S_w^n} = \frac{R_o}{(1-S_h)^n}$, where S_h is the hydrocarbon saturation. F can be obtained by lab measurements, while R_w is obtainable in the lab by calculation from analyses or from S.P. studies. The domin-

ant factor in S.P. values is the electrochemical component $E_c = K \log_{10} \frac{a_w}{a_{mf}}$, and for dominantly NaCl water (not exceeding 90 gm/l) $E_c = K \log_{10} \frac{R_{mf}}{R_w}$.

For constant operating conditions and clean formations it has been observed that induced radioactivity $= B - A \log \phi$ %, A and B being positive constants depending on operating conditions and the nature of the fluid in the hole and in the rocks.

The fluid distribution around a well and the associated resistivities are examined before proceeding to examine the ways in which the above principles can be applied, and to summarise the information obtainable and the conditions under which the various devices should be employed. Resistivity and S.P. measurements are then discussed. G. D. H.

1658. Identification of earth materials by induced gamma-ray spectral analysis. N. L. Muench and J. S. Osoba. *J. Petrol. Tech.*, 1957, **9** (3), AIMME Tech. Paper No. 4484, 89–92.—When a neutron strikes the nucleus of an atom one of several possible reactions may occur. The probability of a process occurring depends on the effective cross-section of the nucleus with respect to that process. γ-Rays may result from the reactions, and these may have characteristic energies which may allow the recognition of the atom bombarded, if allowance can be made for degradation.

The experiments were done with a 55-gal drum containing the materials. The neutron source was 0·1 curie polonium–beryllium near the bottom, shielded by 6 inches of lead, above which was an NaI scintillation detector. The pulses eventually produced via the detector were displayed on an oscilloscope and photographed. The photographic film was analysed using a recording microdensitometer. For calibration purposes several γ-rays of known energy were first studied.

γ-Ray spectra for kerosine and fresh water were nearly identical because hydrogen dominated the processes. Peaks due to Ca and H were recognized when water-saturated crushed limestone was examined. S could be detected when mixed with limestone and water, and the effects of varying the amount of S were studied, peak height ratio increasing with S concn. Similar observations were made on Cl in salt soln, and by calibration Cl concn up to *ca* 100,000 p.p.m. might be estimated. G. D. H.

1659. Conformal representation of various problems of potential in media of different permeabilities. G. Kunetz and J. Chastenet de Gery. *Rev. Inst. franç. Pétrole*, 1956, **11** (10), 1179–92.—The mathematical principles involved in conformal representation are briefly noted, and a series of applications in telluric current prospecting are discussed. 2-dimensional potential distribution is considered, with extension to the cases of 2 or more homogeneous media of different physical properties separated by surfaces of various shapes. Curves depicting the electric field on the external surfaces of the media are given. The examples include a vertical fault, valley and anticline, 2 undulations on a resistant basement, a buried high, an upward thickening of a deep horizon with a horizontal base.

In principle the same ideas are applicable to other problems of flow, and in particular to the flow of fluids in media of different permabilities. G. D. H.

1660. Electrical measuring bridges and beat frequency devices for continuous measurements. M. Kalinic. *Nafta (Yugoslavia)*, 1957, **8** (3), 74–82.—In a very large number of measuring devices of all kinds the beat frequency oscillators and measuring bridges are enclosed. The great accuracy and reasonable simplicity make them useful.

However, in many cases of dynamic measurements, such as the continuous following of changeable temp or levels, these instruments in their basic forms will become unsuitable. In this paper the possibility of making up these devices in a manner to obtain the corresponding instruments for dynamic measurements is discussed, and several examples of calculations and designs are proposed.

The bridges and beat frequency oscillators modified in such a way, making use of either radio waves or physical lines for the telemetry, are also available.

The author finally discusses some of the ways in which the measured magnitudes are to be reproduced on a cathode-ray tube. (Author's abstract.)

1661. Results and interpretation of experimental geochemical studies. K. Strzelecki. *Prace Instytutu Naftowego*, 1955, Series A, No. 40, 9–20.—Geochemical investigations are intended to discover light hydrocarbons in the surface of the earth and to relate their presence to oil reservoirs. 2 "complex" geochemical profiles have been described in the paper, one of a recognized oil-bearing area of Potok and the other of a region between Lodz and Nida basins, the so-called "Przedbor Bridge," which overlays a Jurassic anticline. Here oil can only be suspected, and the geochemical work, although supporting such a hypothesis, needs further support of more orthodox methods. M. S.

DRILLING

1662. Analysis of the rotary drilling technique. Z. Turkowski. *Prace Instytutu Naftowego*, 1955, Series A, No. 36, 1–12.—In view of the limited progress in rotary drilling in Poland, results have been analysed in conjunction with investigations into the drilling technique. The variables of the process have been eliminated and investigated one by one. It appeared that the crews are unfamiliar with this technique and so, very frequently, they carried on without any variations through succeeding geological formations. Graphs showed variation of progress with speed (rev/min) of the turntable, pressure on the tool, rate of flow of mud, and its pH. These have rarely been found correct for the formation traversed, and a great deal of time has been wasted on operations connected with the withdrawal of the string of tools. The suggested improvements have immediately been applied. M. S.

1663. Binding of cement in drilling practice. H. Górka and W. Olszewski. *Prace Instytutu Naftowego*, 1955, Series A, No. 38, 1955, 1–12.—Standard grade of Polish cement known under the trade name of "Saturn" is recommended for all underground work, and its properties in the conditions of work have been fully analysed. Its normal binding time and final strength are affected by presence of mud and underground water. Furthermore, at the higher temp prevailing it starts binding faster. The fluidity of the "Saturn" cement can be prolonged by the use of "Clutan," *i.e.* alkaline extracts from paper manufacture, at the rate of approx 1%. The hardness of the cement suffers through this, however. Deterioration of cement with time has also been looked into. M. S.

1664. Latest ideas in rig hookup. J. Sturm. *Petrol. Engr*, 1956, **28** (12), B30–2.—The latest Rocky Mountain rig embodies a higher mast, enclosed substructure, common engine exhaust, central lubricating system, and permanent BOP control system. E. A. G. H.

1665. Treatment of drilling muds with extracts from brown coal. S. Gierlaszynska and J. Gumułczynski. *Prace Instytutu Naftowego*, 1956, Series A, No. 43, 1–11.—The extracts from brown coal are in fact Na salts of humic acids of unknown composition and colloidal nature, and their addition is widely practised in the U.S.S.R. They improve visc and filtration of drilling muds. Work described was aimed at discovery of suitable coals for the manufacture of such "extracts." Extensive quotations come from the Soviet author Baranov.

Soviet methods for testing drilling muds are also given. Polish IP used Stadnikov's and Ullman's methods ("Enzyklopädie der Technischen Chemie," 1930). To determine the best conditions varying quantities of coal from various mines were reacted with varying quantities of NaOH. This variation shows a max in the amount of humic acid extracted, best results being obtained with 3–4% NaOH, 15–20% of coal, and the rest water, yielding "extracts" with 30–40% of "humic substances." These "extracts" were added in varying proportions to various muds to allow a complete estimation of the improvement in the properties of these. In conclusion, it is stated that apart from particular suitability of coal from certain mines and mud from certain sources the general feature is a pronounced improvement in visc and filtration and in resistance to action of electrolytes. M. S.

1666. Special drilling muds for rotary drilling. J. Gumulczynski and S. Gierlaszynska. *Prace Instytutu Naftowego*, 1955, Series A, No. 37, 1–12.—This work concerns itself with the preparation of muds based on lime, salt, and starch, sodium salts of naphthenic acids, emulsion of oil in water, and "oil"—or rather water-in-oil emulsion. Each mud is subjected to lab tests with chemicals likely to be encountered in the field, and conclusions are listed. M. S.

1667. New tool keeps eye on mud properties. Anon. *Oil Gas J.*, 13.5.57, **55** (19), 88.—A new instrument is described which gives automatic recordings of weight, visc, gel strength, and temp of drilling mud as it circulates from the hole. It is called the Mud Monitor, and it picks up mud from the discharge line and operates only when the mud is circulating. The weight of the mud is measured by a pneumatic force-pressure transducer, actuated by mud in a coil of tubing. Visc is measured by the resistance to flow through this tubing, and gel strength is measured every 55 min over a 5-min period when circulation stops. The peak pressure recorded when pumping is resumed and breaks circulation is the 5-min gel strength. Temp is measured by a thermometer in the flow line.

The instrument requires little attention. A diagram of the type of record produced is given. C. A. F.

1668. Test for degree of dispersion in drilling muds. H. C. H. Darley. *J. Petrol. Tech.*, 1957, **9** (3), AIMME Tech. Paper No. 4481, 93–6.—The dispersion considered is the separation of the stacked plates of clay minerals into platelets, and is distinguished from flocculation–deflocculation phenomena, in which voluminous sediments are stable under quite high centrifugal fields because of edge to plate arrangement.

1 cc of the test mud was shaken with 100 cc of 1-N NaCl in an ASTM oil centrifuge tube and centrifuged for 5 min in an International No. 2 centrifuge at 2000 rev/min. The vol of sediment was noted. Comparisons were made with optical density data and with gel strength measurements for clay suspensions with different amounts of added electrolytes, and all showed breaks in the curves at the same electrolyte concn. Optical density is considered a good comparative measure of particle size. G. D. H.

PRODUCTION

1669. Buckling of tubing in pumping wells, its effects and means of controlling it. A. Lubinski and K. A. Blenkarn. *J. Petrol. Tech.*, 1957, **9** (3), AIMME Tech. Paper No. 4482, 73–88.—The bottom part of freely suspended tubing buckles on the pump upstroke and straightens on the downstroke. The reasons for this behaviour are discussed. The buckling leads to rod-on-tubing wear, excessive polished rod load, and additional power consumption. Tension anchors, tail pipe, and sucker rod guides can be used either to reduce buckling or to minimize the effects of buckling. Some of these devices will also prevent breathing and so improve pump volumetric efficiency.

Field applications have demonstrated the effectiveness of some of the measures considered. G. D. H.

1670. Selective plugging of waterflood input wells; theory, methods, and results. J. N. Breston. *J. Petrol. Tech.*, 1957, **9** (3), 26–31.—Selective plugging aims at causing injection water to enter the less permeable zones after pores or fractures in the more permeable zones have been plugged. The plugging materials are finely divided solids and semi-solids dispersed in a suitable liq such as oil or water. Some of the plugging materials are soluble in alkalis or in acids, so that over-treatment can be corrected. In some cases during emplacement less than full pressure may be applied so that there is back-flow from tight zones while inflow continues in open zones.

A series of cases of selective plugging are described. These include open zones, fractures, fractures in shale below sand, leaky packers, and poor casing seats. G. D. H.

1671. Standard layouts for oilfield pump controls. H. S. Kindler. *Petrol. Engr*, 1956, **28** (12), B96–9.—Standard systems have been developed to control pump discharge ratio and pressures in oilfield applications. The cases considered involve constant-speed motor-driven centrifugal pumps and reciprocating pumps, and direct-acting steam or gas reciprocating pumps. E. A. G. H.

1672. Measuring quality of injection waters. M. Felsenthal and B. L. Carlberg. *Petrol. Engr*, 1956, **28** (12), B53–8.—The flow rate through a millipore filter indicates tendency of water to plug formations. Collected solids can be analysed in lab. A portable apparatus has proved useful for selecting water possessing the least plugging tendency and for evaluating how effectively field treating systems remove suspended solids from the water. E. A. G. H.

1673. Calculating a gas-lift installation. W. B. Adair. *Petrol. Engr*, 1956, **28** (12), B41–51.—Modern engineered gas-lift systems employ the new spring-loaded fluid-operated type valve, the mode of operation of which is described. Methods of calculation are derived for intermittent and continuous produced gas-lift wells. To illustrate actual designs, various field cases are illustrated. E. A. G. H.

1674. Casing string design—handling and usage. J. W. Peret. *Petrol. Engr*, 1956, **28** (12), B33–40.—Since the largest material cost in well installation is casing, it is essential that it be kept at a minimum by good casing design and application practice. A comprehensive survey of all aspects of casing design is given, together with conclusions reached. E. A. G. H.

1675. Subsurface sealing of tubing thread leaks. M. E. True and W. M. O. Reilly. *J. Petrol. Tech.*, 1957, **9** (3), 67–9.—Tubing joint leaks in high-pressure gas wells are a source of trouble, and much work has been done to try to prevent them and to cure them without removing the tubing. The most satisfactory field sealing material had an aluminium stearate base thinned to suitable consistency and carrying a mixture of fine graphite and graded silica. Preliminary work was done on devices for detecting leaks, and for placing the sealing cpd.

However, a squeeze emplacement technique was devised, and this has given satisfactory results in 89% of the jobs attempted. G. D. H.

1676. Quantitative log analysis. Pt 6. How to determine porosity and formation resistivity factors. R. G. Hamilton and P. Charrin. *Oil Gas J.*, 6.5.57, **55** (18), 109.—3 methods of determining porosity (ϕ) and formation factor (F) are given: (1) ϕ from core analyses, from which F may be obtained using the formulæ of Archie, Humble, or others; (2) ϕ and F

from hydraulic microsurveys; and (3) ϕ and F from non-invaded resistivity curves. Nomographs are given enabling porosity and formation factors to be calc from microsurvey measurements on clean formations. C. A. F.

1677. Saturation and porosity from electric logs in shaly sands. Pt 2. A. J. de Witte. *Oil Gas J.*, 15.4.57, **55** (15), 115.—SP characteristics in clean and shaly oil and water sands are discussed, and it is shown that, as the resistivities of the connate water and mud filtrate increase, a shaly sand behaves more like a shale. At high resistivities the SP approaches zero. Nomographs for the determination of water saturation and porosity of shaly sands are given. 18 refs. C. A. F.

1678. Crude petroleum recoveries under solution and gas pressure. Pt 2. R. V. Higgins. *Rev. Pétrolière*, Sept. 1956, (983), 31–7.—Tarner calculates petroleum recoveries utilizing curves B and C of k_g/k_o measured respectively on the formation and in the lab—by the method of Mueller and his collaborators—and the physical properties of crude petroleum. Recoveries calc by Tarner's method are not very sensitive to small errors in selection or determination of the reservoir formation properties, *e.g.* relations between k_g/k_o and the saturation or the reservoir rock properties with regard to liq. Probably the most serious error would be that resulting from a k_g/k_o type of curve, for a deposit where large quantities of gas would have a free path—starting from a gas zone or a *sec* gaseous dome—up to the well. 13 refs. R. T.

1679. Mechanical shaft seals, their pressure–velocity limitations. R. E. Morgan and H. B. Hummer. *Petrol. Engr*, 1956, **28** (12), C34–8.—Balanced and unbalanced types are considered. Tests with water and gasoline at ambient temp, on seal faces of various cpds, and combinations of cpds are summarized graphically. E. A. G. H.

1680. Neutron capture gamma-ray spectra of earth formations. P. E. Baker. *J. Petrol. Tech.*, 1957, **9** (3), AIMME Tech. Paper No. 4483, 97–101.—The frequency or energy spectrum of the neutron-capture γ-rays could, if obtainable, give information on the elements producing the spectrum, and this would be valuable if it could be applied in well-logging. In a borehole the spectrum obtained is not the same as that for a small specimen, because not only is the formation involved but also the mud and detector housing. There are also some detector effects involved.

The experimental apparatus was a tank 5 ft high and 3½ ft dia, with a central pipe for the borehole, the annulus containing the artificial formation. The sonde was centralized, and had a polonium–beryllium source and a thallium-activated sodium iodide crystal in the scintillation detector. The formation was crushed or loose material of 35–50% porosity, usually saturated with water or brine. The 6-, 8-, or 10-inch hole had 120-lb/cu. ft. mud in some tests, but this had practically the same effect as water, and so water was used in many runs. The relationship between pulse height and energy was obtained by calibration. The rocks were sands, crushed limestone, crushed dolomite, synthetic anhydrite or gypsum.

Plots of count against energy are given for the various systems studied. For 40,000 p.p.m. salt water in silica sand the Cl peak was detectable, as well as peaks for H and Si. Ca peaks were observed with limestone and dolomite, as well as a weak Mg peak in the latter case. S but not C was detectable on the spectra. Runs in 6-inch and 10-inch holes were essentially the same for sands and fresh water, and drained-down crushed rock gave the same type of results as that with the spaces between the fragments water-filled. G. D. H.

1681. The unsteady-state behaviour of linear gas-storage reservoirs. J. E. Warren. *Petrol. Engr*, 1956, **28** (12), B60–86.—This problem is treated mathematically with assumptions of homogeneous and continuous rock properties, isothermal laminar flow of a gas having a uniform composition and negligible gravity effects. The conclusions derived are: (1) behaviour of gas-storage reservoirs of the type considered can be predicted with a reasonable degree of accuracy by the linearized method; (2) the perfect gas type of solution is not valid in cases where compressibility and visc vary widely. Numerical solutions presented apply to perfect gases if proper substitutions are made; (3) the expanded form of the governing equation can be solved numerically; (4) a method for handling problems involving discontinuous reservoir operation is presented. E. A. G. H.

1682. Evaluating D.S.T. data. Pt 2. How pressure build-up theory applies to drill-stem test. A. J. Zak and P. Griffin. *Oil Gas J.*, 29.4.57, **55** (17), 193.—The basic assumptions and boundary conditions involved in the derivations of pressure build-up equations are discussed, together with their applications to drill-stem testing. Diagrams of hypothetical drill-steam test pressure curves are given, showing the effects on the curves of visc, permeability changes, well-bore damage, and severe skin. It is shown that theoretical curves are affected appreciably by skin factor and permeability. Field tests have shown, however, that reliable results can be obtained from the build-up equations in many cases, even when actual conditions differ appreciably from theoretical conditions. C. A. F.

1683. Effect of rate on oil recovery by water flooding. J. K. Jordan, W. M. McCardell, and C. R. Hocott. *Oil Gas J.*, 13.5.57, **55** (19), 98.—The results of an extensive study of the effect of rate of injection on oil recovery in water flooding are presented in detail.

Performances of actual floods were examined, technical literature was studied, and theoretical and lab studies carried out, the results of which are given. The general conclusions are: (1) that high rates of injection with capacity production are not necessary to obtain max ultimate recovery; (2) water floods can be curtailed without loss of oil recovery; and (3) in natural reservoirs, which usually consist of heterogeneous formations, reduction in the rate of water advance may improve recovery due to more uniform flooding resulting from capillary forces. 53 refs. C. A. F.

1684. Oil and gas conservation in Venezuela. J. M. Battisti, S. Vasquez, and L. Herrera. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 21–30.—In Venezuela both the Government and industry feel that conservation is almost synonymous with sound and efficient oilfield practice, and a realistic attitude has been maintained which recognizes the economic aspects of the problem as well as its physical and technical sides. No serious problem exists regarding conservation of free gas, but a very real conservation problem is created by the production of a large vol of by-product gas associated with oil production. The industry is acutely aware of the problem, and is continually endeavouring to obtain the max recovery of oil and to increase gas utilization as rapidly as the country's economy will permit.

Sound engineering and efficient reservoir control measures have been voluntarily followed by the industry, and optimum drilling programmes have resulted in minimum existence of wasteful production practices. A comparison of Venezuelan withdrawal rates with those of the U.S.A. emphasizes the adherence to modern, efficient production principles. Although many Venezuelan oilfields are not suited to water flooding, this technique has been successfully applied in a few instances. Gas injection facilities have been installed in a much larger number of fields for the purpose of pressure maintenance, and a list of existing and projected plants is furnished. The 4 objectives of pressure maintenance are to increase ultimate recovery, to lengthen the flowing life of oil wells, to conserve and store gas for future use, and to increase

efficient recovery rates. Approx 170 billion cu. ft. of gas was utilized in 1953, and natural gasoline plants processed 106 billion cu. ft. during the same period. Additional details regarding utilized and proce.sed gas are given. High gathering, compressing, and injection costs results in poor economic prospects for underground gas storage unless such storage is incidental to stimulating oil production.

The ownership of mineral rights by the Venezuelan nation and the comparatively large size of concession blocks result in a minimum number of competitive production operations. By adhering to sound and efficient operating principles, the industry has avoided the necessity of restrictive legislation and close Government control. The petroleum industry and Government have co-operated in unitizing reservoirs where such action proved essential.

A sound oil and gas conservation policy has benefited both the industry and the nation. The increased recovery obtained by good conservation practices leads to a high degree of utilization of production facilities, and increased gas utilization provides a cheap source of energy and raw material. These factors have been, and continue to be, very important in the development of the national economy.

The increased trends toward gas utilization and additional oil recovery through production stimulation methods are indicative of the progress of conservation in Venezuela. It is estimated that by 1960 over 50% of all the produced gas will be utilized. This progress is in line with the overall industrial and ıocial progress of the nation.

(Authors' abstract.)

1685. Widening vistas in Venezuela. Anon. *Petrol. Press Serv.*, 1957, **24**, 247–50.—Recent grants of over 820,000 hectares of new oil concessions—the first since 1944—will strengthen Venezuela's position as principal oil exporting country, accounting last year—with a peak production *ca* 900 million brl—for 17% of free world output. Proved reserves increased to 14 billion brl at the end of 1956, due more to revaluations than new fields. Production was 2·95 million b.d. at the end of March, pre-crisis level was 2·5 million b.d. The No. of exploratory wells was 138 in 1936, in 1955 171. Output at the end of May was *ca* 2·93 million b.d., approx 1069 million brl/year; at this rate reserves represent only 13 years' supply. Concessions cover only *ca* 6·7 million hectares of the country's approx 40 million hectares. The country's phenomenal prosperity is due largely to the high output of the Bolivar coast fields, from their extensions under Lake Maracaibo, and from the Mene Grande. Active exploration is proceeding in the Trinidad part of the Gulf of Paria. Immediate increase in production will result from completion, this Autumn, of a 20-inch pipeline to Puerto Cabello, serving Barinas field. The U.S.A. is the largest importer of Venezuelan oil—last year 39% of *ca* 870 billion brl—which is exempt from import restrictions. Venezuela's expanding refining capacity = *ca* 605,000 b.d. Throughput last year was 228·3 million brl on ¼ of total production. An obligation exists to refine within the country <15% of produced crude. Government revenues last year were Bs 4400 million (3·33 Bs = 1 $)—over 3000 million from oil company payments—including Bs 1000 million initial payment for concessions. R. T.

1686. Aramco's success story continued. Anon. *Petrol. Press Serv.*, 1957, **24**, 259–61.—Despite currency difficulties, each year's production has exceeded that of every previous year, and 1956—according to Aramco's booklet—was no exception, with an average of 986,130 b.d. Owing to the Suez crisis, 1957 production may be down. Proved reserves—> those of the U.S.A.—at the end of 1956 were estimated at 34 billion brl. The oustanding discovery was at Khursaniyah; exploration is proceeding. A gas-injection plant is being designed to inject some 200,000 ft³/day into the 'Ain Dar area of the Ghawar field. Last year the Abquaiq plant injected H.P.-gas associated with oil production into the top of the Abquaiq structure at an average rate of 146,300,000 ft³/day. At the N. end of the field water was injected at the rate of 40,000 b.d., later to be increased to 300,000 b.d., at a total cost of $3·5 million. Facilities for Safaniyah field—including $11 million for the 142-mile 22-inch pipeline to Ras Tanura terminal—have cost $21 million. The municipality of Riyadh, the Saudi Arabian capital, is planning a 450-km pipeline to carry natural gas to the city, where much building is in progress. Oil revenues of the order of $280 million p.a. were checked by the Suez crisis, and Saudi Arabia is now short of foreign exchange. R. T.

OILFIELD DEVELOPMENT

1687. Lagging U.S. reserves. Anon. *Petrol. Press Serv.*, 1957, **24** (5), 166–9.—The net increase of 422 million brl in U.S. proved crude reserves represents little more than 1% over reserves at the end of 1955. Including natural gas, net increase of oil reserves = 886 million brl, an advance of *ca* 2·5%. This increase of 800–900 million brl is *ca* the average for period 1952–56. It corresponds roughly to an increase in annual productive capacity of approx 90 million brl, 250,000 b.d. In recent years U.S. crude oil production has grown steadily, but annual gross additions to reserves have fallen. These trends, if continued, would lead to static or declining reserves and growing reliance on imports, perhaps also on indigenous shale oil. New factors point to growing increase in reserves, but these may not keep pace with rise in demand. Increased imports will be needed, therefore, and exports must continue to decline. To maintain present ratios between U.S. domestic production and reserves, and between production and imports in the period up to 1965 would require an average annual rate of gross additions to proved reserves *ca* 50% higher than in recent years. This can be attained only at greater expense, deeper drilling, improved recovery methods, etc. Promising new areas are in the Rocky Mountain States and the Gulf of Mexico. R. T.

1688. Let's take another look at the "obvious." F. J. Gardner. *Oil Gas J.*, 6.5.57, **55** (18), 177.—The Cedar Creek anticline in SE. Montana has been known since 1910, and gas was first found in the Cretaceous in 1913, and over 400 gas wells were subsequently drilled. Only 6 deep tests were drilled between 1923 and 1950, and deep oilfields were not found on the structure until 1952. Since then 15 oilfields have been found, and these are producing from Mississippian, Silurian, and Ordovician rocks below 7800 ft.

E. of Cedar Creek is the Wibaux nose, a plunging anticline, and there should be good possibilities for oil production from this feature. No wells have been drilled on the crest of the structure. C. A. F.

1689. Mexico's shackled efforts. Anon. *Petrol. Press Serv.*, 1957, **24** (5), 164–6.—Pemex, the State oil entity, controls—since expropriation in 1938—Mexico's oil industry. In 1956 crude oil output was <2%> in 1955, inland demand—approx 87 million brl—was *ca* 12%> in 1955. Pemex imported 17 million brl refined products—*ca* ¼ of the country's total needs—in 1956. Owing to geographical conditions, some areas will be served economically from contiguous U.S. areas. In vol terms Pemex is a net importer, but—owing to uneconomical selling prices—incurs a cash deficit. Pemex must find oil in the N. and acquire capital to extend pipeline, refining, and distributing facilities, or Mexico will become—in the not too distant future—a net petroleum importer. The Manatitlan 50,000-b.d. cat cracker, completed in 1956, is connected with the Pacific Coast by a 20,000-b.d. products line. Poza Rica area accounts for *ca* 40% of the total crude ouput. All Mexico's crude comes from low-lying areas

bordering on the Gulf of Mexico. Offshore drilling is under way. Reserves of natural gas are estimated at 7560 billion cu. ft. By agreement 115 million cu. ft/day (possibly double this quantity) will be delivered to the U.S.A. Hopeful discoveries have been made in Tamaulipas in the N., where oil has been found in the Jurassic, and in the San Andres field—Vera Cruz State—*ca* 10 miles SE. of Poza Rica area's S. limit. This field yields 32° API crude from the Cretaceous at *ca* 11,000 ft. R. T.

1690. Resurgent Persia. Anon. *Petrol. Press Serv.*, 1957, **24** (5), 171–3.—The report of the consortium operating companies in Persia shows substantial advances in production, refining, and exports for 1956. Oil revenues accruing to the Persian Government and N.I.O.C. exceeded £54 million, and foreign exchange brought in for local expenditures exceeded £15·7 million. Since direct oil revenues are made also in foreign currency, the oil industry contributed £70 million to Persia's foreign exchange resources. Production of crude oil by the operating companies totalled 25,934,000 long tons—535,500 b.d. in 1956—compared with 15,776,000 tons—325,000 b.d.—in 1955. Agha Jari—the most important producer—yielded 371,500 b.d. from 21 wells; facilities are being constructed to raise the field's potential capacity to 600,000 b.d. Exploration in the area covered by the operating companies in the SW. has been resumed. The Italian state oil concern A.G.I.P. will form with N.I.O.C. a company SIRIP, owned jointly in equal shares, for exploration and joint development in 3 new areas. R. T.

1691. Parentis concession. Anon. *Rev. Pétrolière*, Sept 1956, (983), 46–8.—After 2 years' striving, Esso Petroleum Research and Prospecting Soc has obtained the Parentis hydrocarbon concession. The principal articles of the decree of 11 Aug 1956 relating to this concession and the specifications annexed to the present decree are presented. R. T.

1692. Reds develop small field in Bulgaria. Anon. *Oil Gas J.*, 6.5.57, **55** (18), 95.—Bulgarian production in 1956 is reported as 4500 b.d. compared with *ca* 3000 b.d. in 1955. A new field is reported nr Kavarna in Drobruja, NE. Bulgaria, and this has been developed.

By 1960 refinery capacity in the country is expected to be 2400 b.d. or *ca* 50% of current output. C. A. F.

TRANSPORT AND STORAGE

1693. Loss control in transportation and storage of petroleum and petroleum products. J. H. McClintock. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 1–19.—In this paper an attempt is made to: (1) estimate the magnitude of the actual loss of petroleum and petroleum products between the well-head and the consumer; (2) isolate these losses by each major phase of the operation; (3) indicate the sources of individual losses in each phase; and (4) propose certain basic principles for the control of oil losses in crude oil production, transportation, and refining, and in the distribution and sale of the refined products. Some methods used to reduce losses are discussed, and some ideas on how to organize a programme for effective action are presented for consideration. It is hoped that this paper might make some small contribution to the petroleum industry's efforts to conserve a limited natural resource, *i.e.* crude oil and the products thereof. (Author's abstract.)

1694. The problem of safety in natural gas transmission and distribution. F. Salimbeni. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 147–59.—The problem of safety in natural gas transmission and distribution is discussed in its main aspects as determined by 2 different forms of hazard: internal for those who operate in the field of construction, operation, and maintenance of facilities, and external for those who are incidentally involved by the proximity of the plants. The criteria which must govern the framing of preventive measures for accidents occurring to individuals have therefore been briefly mentioned. Great importance is given to external hazard, classified under 2 particular forms: intrinsic hazard, determined by physical properties of the gas transmitted and function of characteristics of facilities, and extrinsic hazard, depending exclusively on circumstances beyond the facilities themselves. Preventive measures and modern trends in choice of materials, safety, and control devices to obtain high degrees of safety have been briefly mentioned in relation to intrinsic hazard. Extrinsic hazard has been discussed in greater detail in relation to the surrounding environment of facilities, and criteria have been set forth for quantitative and qualitative evaluation thereof, with suggestions for a method of secondary protection, prompted by considerations based on the theory of gas leaks. It has also been stated that, as hazard, *cæteris paribus*, is a function increasing with pressure and decreasing with distance, it is possible to vary pressures and distances according to the variation of one of the 2 parameters, so as to keep hazard within admissible values of the same magnitude. The problem of safety is finally examined from the economic point of view, calling attention to the fact that, before the occurrence of enormous material and moral damages which an accident may provoke, financial investments in safety measures are actually a saving for industry. (Author's abstract.)

1695. Design and operation of marketing terminals. C. R. McMillin. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 61–72.—The objective of marketing is to assure an adequate supply of products for customers and to accomplish this at the lowest practical cost. Marketing and distributing terminals are one way of accomplishing this objective, and an integrated study of available business, transportation costs, methods of supply, and construction costs is essential for determining the economic justification for a marketing terminal. The layout of facilities and the selection of all operating equipment must be such as to safeguard the products and to provide for handling them in the most expeditious manner at a minimum operating cost. As the loading rack at a terminal is a focal point of operations, the objectives in its design are: (1) safety to personnel, products, plant, and equipment; (2) accurate stock control; (3) fast loading of trucks. Accurate meters and billing by ticket printing metering devices is the most modern method to use. In the operation of a terminal the handling of trucks with the minimum of lost time is assured by an integrated operation such as: (1) taking of orders from customers or from a district marketing office; (2) traffic routing; (3) truck dispatching; (4) routing of trucks; (5) receipt of cargo. A central control is the best method to perform these integrated services, and all phases of terminal operation can emanate from this control centre. From this control bay, meters on the tank truck loading rack can be put into operation, safety controls can be activated, and a tube dispatch system to the loading racks can be employed, together with loudspeakers which will facilitate the operations and reduce time of drivers or loaders.
(Author's abstract.)

1696. How Shell's Antelope L.A.C.T. works. E. McGhee. *Oil Gas J.*, 3.6.57, **55** (22), 90.—An account is given of Shell Oil Co's experience with its automatic-custody-transfer battery at Antelope, Texas, which concerns passage of 300 b.d. of crude oil to Sinclair Pipe Line Co. Installation is trouble-free, reliable, accurate, and economic. G. A. C.

1697. Bulk plants receive stocks automatically. W. D. Lomax and H. W. Wilker. *Oil Gas J.*, 27.5.57, **55** (21), 113.—A description is given of the experimental installation at the Standard Oil Co plant at Colon, Michigan, for remote control from the Chicago office for unattended pipeline deliveries. Advantages are listed, and include reduction in vapour losses, reduction in terminal tankage, elimination of manpower hours to load tanks cars, insensitivity to weather conditions, and reduction in paper work regarding stock orders and follow-up correspondence. G. A. C.

1698. Petroleum ports. H. Deschenes. *Bull. Ass. franç. Tech. Pétrole*, 1957, 163–98.—Lecture, under 3 main heads of ports and transport (port size and location relative to crude source and pipeline alternative, present limitations of No. of ports available to large tankers), harbour works (maintenance costs and effect of vessel size on such costs, examples from operation of Le Havre), services (discharging, bunkering, repairs, and dry dock facilities). Concluded that it is essential for large tankers to be built and for European ports to be modified to accommodate them; pipeline costs are not susceptible to same potential reduction as tanker transport costs. V. B.

1699. The petroleum industry and national transportation policy. G. P. Baker. *Proc. Amer. Petrol. Inst.*, 1956, **36** (V), 21–5.—The petroleum and transportation industries are closely interrelated. Neither could function without the other, since each is the other's best customer, and each offers a product or service that is essential to the other. This interrelationship extends throughout the entire transport field, encompassing highway, pipeline, water, rail, and air carriers. It even extends to the field of taxation in the form of excise taxes.

The petroleum industry's stake in transportation, both private and for-hire, behoves its objective participation in efforts to strengthen our overall transport system. It should, therefore, continue, in its own long-range interest, to recognize and assist in solving the problems of our publicly regulated carriers in order to assure the strongest possible for-hire transport industry under private enterprise.

(Author's abstract.)

1700. How four storage tanks got a thorough cleaning. W. R. Jameson and H. B. Green. *Oil Gas J.*, 24.6.57, **55** (25), 126.—4 case histories are given of tank cleaning by new methods based on use of chemicals and special applicational devices, and efficiency of these methods compared with the old hand-cleaning procedure. Solvents used include alkaline substances, acids, petroleum-based and chlorinated solvents, and various emulsions. G. A. C.

1701. Sea transport of petroleum. M. Perrachon. *Bull. Ass. franç. Tech. Pétrole*, 1957, 77–101.—Freight components, USMC and Scale rates, tanker cost breakdown, and pattern of freight market are discussed. World tanker fleet (which at Jan 1957 consisted of 45 million tons + 5 million tons building + 21 million tons on order), is divided as to 43% owned by petroleum companies and 57% by independent owners (of which 31% is on time-charter, 14% on voyage charters exceeding 1 year, and 12% available in market). Factors governing tanker size and speed are considered, with especial reference to Suez *v.* Cape routes, and also choice of motive power (steam turbine *v.* diesel). V. B.

1702. 33,000-ton tanker with a.c. auxiliaries. Anon. *Mot. Ship*, June 1957, **38** (445), 99.—Brief description is given of the 11,250-b.h.p. Kockums-M.A.N. turbo-charged tanker *Butmah*. 2 photographs. No engine details are included. D. K.

1703. The economics of supertankers. R. Casquet and H. Deschenes. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 21–32.—In order to meet the increasing demand for oil tankers, shipowners have been passing orders for ships of ever-increasing tonnage. But there are many factors contributing to set a limit to this tendency. The size of the tanker depends on its draught: the search for a minimum transport cost per ton-mile leads to the adoption of the solution of "economic speed," which gradually increases with the tonnage, and to the fixing of the draught at *ca* 38 ft, which is compatible with the present or future capacity afforded by the principal oil ports, yet still incompatible with the Suez Canal navigability. The corresponding dead weight is thus *ca* 48,000 tons. (Authors' abstract.)

1704. Recent developments in oil tanker equipment. J. Lamb and J. W. Strang. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 33–59.—This paper is devoted to those parts of an oil tanker's equipment which have a direct bearing upon the handling of petroleum cargoes. After a brief comparison between pre-1939 and post-1945 tankers as regards size, speed, and cargo pumping capacity, the authors give reasons for quicker turn-round in port. The delay which occurs when a tanker berths, due to shore personnel not being able to board the ship until after it is securely moored and the gangway lowered, is dealt with, and proposals made to cut down this delay. Higher cargo handling rates, so necessary for quick turn-round, introduce, in the opinion of the authors, greater accident risks. To avoid such undesirable conditions they have given considerable thought to improving the relevant parts of a tanker. These are described and illustrated in the paper. Single and twin pump-room tankers are discussed and proposals made to obtain the advantages of both without the disadvantages of either. This includes an entirely new arrangement of pipes and valves in cargo tanks, which is described and illustrated. The advantages of centrifugal type cargo pumps are outlined and proposals made for overcoming the risk of bulkhead gas-sealing glands overheating and igniting explosive gases that may be present in tankers' pump-rooms. (Authors' abstract.)

1705. Tankers and world shipping. Anon. *Petrol. Times*, 5.7.57, **61** (1563), 569.—A review is given of *Lloyd's Register of Shipping* Annual Report for 1956 with extracts and comments. An interesting point emerges that of new tankers under construction at Dec 1956, motor ships represented 31%, a decrease, while large steam turbine tankers are increasing in number. G. A. C.

1706. Brilliant future predicted for the oil and gas pipeline industry. Anon. *Pipe Line News*, 1957, **29** (2), 33–41.—A review of the industry from addresses given at the Jan 1957 convention of the Pipe Line Contractors Association at Boca Raton, Florida. D. B. S.

1707. Colombian Petroleum to lay world's largest aluminium pipeline. Anon. *Pipe Line News*, 1957, **29** (4), 51.—Colombian Petroleum plan to lay 42 miles of 6-inch dia aluminium crude oil pipeline. This type of pipe may be more conveniently handled in jungle areas, and in addition corrosion resistance is high and transport costs low. The pipe is to be laid bare and will not be ditched. D. B. S.

1708. Offshore lay barge commissioned. Anon. *Pipe Line News*, 1957, **29** (4), 27.—A barge specially constructed for laying offshore pipelines in the Gulf of Mexico is described. The barge, which is 260 ft long, is designed to lay up to 5000 ft of pipe during a 24-hr period. D. B. S.

1709. The coal pipeline. F. Culpepper. *Pipe Line News*, 1957, **29** (2), 26–8.—The development work carried out on the pumping of coal as a coal–water slurry is described. Some details are given of the factors involved, and also of a full-scale pipeline which supplies 1,300,000 tons of coal p.a. over a distance of 110 miles. D. B. S.

1710. Electronic protective devices for pumping units. H. Ginns. *Pipe Line News*, 1957, **29** (4), 32–5.—Electronic equipment which affords protection against high motor and pump bearing temp, high pump case liq temp, high vibration level, and low or high pump or line pressure is described. D. B. S.

1711. Prediction of surge pressures in oil pipelines. R. D. Kersten and E. J. Waller. *Pipe Line News*, 1957, **29** (3), 33–40.—The problem was shown to be such that a method of hydraulic circuit analysis could be formulated analogous in many ways to an electric circuit analysis. Tests were successfully performed on actual pipelines, using standard pumps and varying the conditions of pumping to afford a wide range of characteristics. A hydraulic–electric analogy lends itself to the use of electronic-computer techniques for the solution of problems. D. B. S.

1712. Hydraulics for pipelines. Pt XXI. Losses through fittings. C. B. Lester. *Pipe Line News*, 1957, **29** (4), 20–6.—For small- and medium-sized pipelines the losses through fittings in the pump house, etc., may be ignored, as they are rarely more than 2% of the total friction loss. In large dia lines the manifold valving and piping is often " streamlined " to a smaller dia, and in these cases losses may be appreciable. Losses through fittings should also be included when working on the tank side of an initiating station.

Losses may be estimated from the nomogram or from equations which are given. Data for the constants used in the equations are compared. D. B. S.

1713. Digital telemetering and print out of pipeline information. M. T. Nigh. *Pipe Line News*, 1957, **29** (2), 65–70.—Remote operation of a pipeline necessitates bringing considerable information to a control point from the subsidiary stations. The use of digital telemetering in this application is described. The method is accurate and reliable and provides data in convenient forms for re-transmission or computation. D. B. S.

1714. Automatic custody transfer of crude oil. H. C. Packard, H. S. Kelly, and A. H. Newburg. *Pipe Line News*, 1957, **29** (2), 42–51.—The problems and requirements associated with the gauging, sampling, and testing of petroleum products in a highly automated pipeline system are discussed generally, but also from the producer's and pipeliner's viewpoint. D. B. S.

1715. New ASCE Pipe Line Division meets in Annual Session. E. Sterrett. *Pipe Line News*, 1957, **29** (3), 41–2.—Reports on 6 papers presented at a meeting of the new Pipe Line Division of the American Soc of Civil Engineers in Feb 1957. Subjects include gas flow, fluid dynamics, river crossings, pipeline stresses, and hydrostatic testing. D. B. S.

1716. River crossing protection for gas pipelines. H. A. Altorfer. *Pipe Line News*, 1957, **29** (2), 29–32.—For ease of maintenance duplicated lines are normally used for river crossings in high pressure gas transmission systems. In the event of failure normal line break control systems close all valves in the vicinity of the break, but a system is described in which the unbroken line reopens automatically to ensure practically uninterrupted flow of gas. D. B. S.

1717. How to use banded-wire strain gauges for determining secondary stresses in pipelines. D. L. Skipp, G. M. McClure, and H. J. Grover. *Petrol. Engr*, 1956, **28** (12), D35–43.—This article contains sections on the discussion of secondary stress and the use of banded-wire strain gauges on pipeline systems. E. A. G. H.

1718. On limitations of the right of property owing to the laying of methane piping. S. Ilardi. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 63–76.—The writer states the object of the inquiry, which consists in the study of the new legal problems concerning the conflict between the requirements of the concerns transporting gaseous hydrocarbons and the rights of the individual or piblic administration on whose property the piping is laid. Furthermore, he points out the object of the rights accruing to such concerns, as well as of the corresponding obligations. The writer then answers the question as to how the servitude of methane piping may be established, according to whether it is exercised on private or public property. The report gives information on predictions which may be made, on the ground of the new bill now in preparation, as regards the future rules concerning the construction and operation of methane piping. Finally, the report contains some remarks concerning the necessity of suitable amendments to the bill. (Author's abstract.)

1719. Propane can be pipelined. F. B. Neptune. *Oil Gas J.*, 29.4.57, **55** (17), 130.—Experience is given of Phillips Petroleum Co and Phillips Pipe Line Co in pumping propane and butane. Requirements for pumping propane include conversion to mechanical seals, and use of higher pump intake pressures. Suitable buffers must be used when pumping L.P.G. through same line with dist, and special precautions taken when repairing leaks. G. A. C.

1720. Economic and technological consideration in recent Canadian pipeline developments. J. F. Fairlie and F. C. Lantz. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 73–94.—The emergence of Canada as a crude-producing country and its effect on pipeline development are brought into light. Pipelines constructed in the period 1947–53 are described, with an outline of the major technological considerations involved, and of the main design characteristics of these pipelines. (Authors' abstract.)

1721. The design and construction of underwater pipelines. J. E. Green and H. H. List. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 95–114.—3 major methods of laying underwater pipelines have been developed. In the first 3 sections of the paper the methods are reviewed, and the Lake Maracaibo crossing (Venezuela), Coro crossing (Venezuela), and Straits of Mackinac crossing (U.S.A.) are discussed in detail. The methods employed in laying each of these lines differed radically and were determined after giving proper consideration to the max depth of water, necessity of maintaining marine traffic, velocity and direction of wind, size of waves, velocity and direction of water currents, incidence and severity of storms, bottom conditions, equipment available, and probable least cost. The fourth section discusses trenching and backfilling for underwater pipelines. (Authors' abstract.)

1722. Pipelines for viscous fuels. P. E. Ford. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 115–29.—This paper deals with the results of recent investigations into the transport of viscous fuel by pipeline and how the experimental data obtained may be applied to pipeline design. In general, the non-isothermal flow which is encountered in the pipelining of viscous fuels is discussed, and design data obtained from large-scale field trials on the heat transfer from the oil and on the pressure drops associated with this type of flow are given. From this design data pressure drop/throughput curves for typical buried lines have been calculated. These curves are of an unfamiliar shape, rising to a peak pressure at low throughput and then falling to a minimum value before rising again. This peak pressure can dictate the pipeline dia to be used. The starting up of lines full of cold viscous oil is discussed, together with some experimental data which is given on the heating of lines by internal electric cable. In addition, some experimental results obtained on interfacial mixing in non-isothermal streamline flow and some soil conductivity investigations are briefly discussed. (Author's abstract.)

1723. Chief characteristics of the pipelines for the transport of liquid hydrocarbons and gas in Italy. E. Donati and U. Biffignandi. *Proc. Fourth World Petrol. Congr.*, 1955, **8**, 131–46.—This report deals with the development of pipelines for the transportation of liq and gaseous hydrocarbons in Italy in the immediate post-war period, subsequent to the construction of new important refineries and to the discovery of large deposits of natural gas in the Po Valley. An account on the principal design and structure characteristics of the Italian gas and oil pipelines is given with special regard to: thrust pressure inside the pipelines; types of tubes used and advantages of high strength 054D Dalmine steel; how the problem of pipeline corrosion is conceived; how to protect pipelines for hydrocarbons; crossings of large rivers. Finally, a report is given on the possibilities offered by the pipeline industry in the important refinery and drilling field.
(Authors' abstract.)

1724. Dry ice works as welding plug. J. D. Lewis. *Oil Gas J.*, 3.6.57, **55** (22), 131.—Dry ice can be used successfully in repairing a pipeline by acting as a fluid dam and vapour diluent in the line. Results are given of field trials.
G. A. C.

1725. High capacity P.D. meters. D. C. McKinley. *Oil Gas J.*, 27.5.57, **55** (21), 108.—A number of commercially-available high capacity positive displacement meters are reviewed and their performance, operation, calibration, and maintenance discussed. Some future developments for pipelines and terminals are dealt with. G. A. C.

1726. Payouts—booster stations *v.* looped lines. V. B. Mavris. *Oil Gas J.*, 27.5.57, **55** (21), 116.—Advantages and disadvantages of automatic *v.* manned stations and loop *v.* automatic booster, station spacing, and payout *v.* capacity increase. The article is illustrated by 11 figs. G. A. C.

1727. Top interest programme ready for API Pipe Line Conference. Anon. *Pipe Line News*, 1957, **29** (5), 26–32.—Summaries of the 6 papers to be presented at the API conference in May 1957. Subjects include automation, metering, safety, and right-of-way problems. D. B. S.

1728. Gilsonite pipeline system now in operation. Anon. *Pipe Line News*, 1957, **29** (5), 86–7.—The 72-mile long, 6-inch dia line which transports up to 700 tons/day of gilsonite ore as an ore–water slurry is briefly described. D. B. S.

1729. Bay crossed by barge and shove. Anon. *Pipe Line News*, 1957, **29** (5), 46.—Methods used in making a 31,500-ft crossing of Lavaca Bay are described. Normal offshore laying procedure could not be followed because 2 existing lines had to be crossed under and a deep water channel negotiated. The method used involved welding the pipe onshore, attaching a guide line under the existing lines, lowering the pipe into a ditch, and then pulling the pipe along the ditch until clear.
D. B. S.

1730. Magnolia needed more compressor-station engine capacity; supercharging gave it. R. G. Bolang and H. B. Emery. *Oil Gas J.*, 24.6.57, **55** (25), 160.—Increased h.p. was economically obtained by supercharging existing 2-cycle engine compressor installation. The limiting factor of scavenging air vol was dealt with by converting one 25-inch dia front stage compressor cyl to scavenger air-service. Other items were installed during conversion, with good results.
G. A. C.

1731. Pipelining crude with 110° F pour point. J. M. Rupert and B. N. van Diemen de Jel. *Oil Gas J.*, 17.6.57, **55** (24), 127.—This second part of the article deals with design of the crude oil and defrosted lines and equipment. Graphs show station spacing, temp drop, and limits for station spacing.
G. A. C.

1732. Suez crisis puts pressure on U.S. pipelines. Anon. *Pipe Line Ind.*, 1957, **6** (1), 20–1.—The Suez crisis—in spite of the Middle East Emergency Committee's (MEEC) efforts—showed up the inability of U.S. pipelines to move substantially enlarged quantities of crude from interior producing areas to seaport terminals. Between 1 Nov and 8 Dec, 14 million brl of crude = 528,000 b.d. was shipped to W. Europe. 9 million brl came from storage. A complete report on oil industry actions to date, including problems involved in movement of crude to the Gulf Coast and on to Europe, is presented.
R. T.

1733. Big increase in construction for 1957. M. A. Judah. *Pipe Line Ind.*, 1957, **6** (1), 22–3.—Laying of 16,850 miles of oil, gas, and product lines in the U.S.A. is forecast for 1957. Construction of 12,390 miles of gas lines, 9210 miles transmission lines, and 3180 miles of gathering lines is predicted. A total of 555,790 gas compressor h.p. is expected to be added in 1957, compared with 588,680 in 1956. Details are given. Activity outside the U.S.A., in Canada, Bolivia, and the Eastern Hemisphere, is described. A pipeline through Israel to bypass the Suez Canal is a possibility. R. T.

1734. Pipe line progress in 1956 points way for future. M. A. Judah. *Pipe Line Ind.*, 1957, **6** (1), 26–33.—New ideas adopted in 1956 in pipeline construction are described with illustrations. R. T.

1735. U.S. contractors conquer Spanish terrain. O. Anderson. *Pipe Line Ind.*, 1957, **6** (1), 34–5.—In spite of damage to construction equipment at sea, by rain, and granite mountain right-of-way, pipe on this new 481-mile line was laid at the rate of 12,000–15,000 ft/day on the Spanish NATO line. This defence plan will include a harbour, naval air station, and a giant air base. R. T.

1736. Trans-Canadian line moves eastward. Anon. *Pipe Line Ind.*, 1957, **6** (1), 41–2.—An illustrated article discussing work now under way on the 2250-mile line connecting Alberta gas fields to E. Canada. R. T.

1737. Calculating three-phase flow in horizontal pipelines. O. P. Sobocinski and R. L. Huntington. *Pipe Line Ind.*, 1957, **6** (1), 43–5.—To design the best piping conditions engineers have needed better pressure drop data to avoid the difficulties and mistakes of trial and error solutions. Many of the answers to these complex flow problems are given in extensive data from studies over a wide range of flow problems. R. T.

1738. Stud welding for cathodic protection. J. S. Johnson. *Pipes & Pipelines*, 1957, **1** (4), 25–7.—Electrically welded pipes give the necessary elec continuity for cathodic protection. With compression joints, *e.g.* Viking Johnson type—sealing attained by rubber compression—comparatively high local elec resistance may be met. Such joints are bonded over to lower the resistance. Of methods tried, gas, electric arc, and thermit welding damage the int lining of bitumen-coated pipes. The stud welding process described and discussed was adopted after numerous trials. In field work elec resistance of the pipeline is measured at intervals with a Bridge Megger to ascertain high resistance pt, *i.e.* pipe joints. An instance of application is described where pipeline location and geographical features made difficult measurement of the current required to give protection. R. T.

1739. Some problems in underground pipe design and in pipelaying (2). N. W. B. Clarke. *Pipes & Pipelines*, 1957, **1** (4), 18–24, 31.—Factors governing load-carrying capacity of an underground pipe and relevant pipe classification are presented. Properties of the piping—flexible or rigid—with

relation to characteristics and density of the soil are discussed. The fundamental importance of 2-edge testing is emphasized. R. T.

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The petroleum industry must co-operate with the electrical manufacturers and the code-enforcing authorities to establish the functional requirements for Division 2 apparatus, and to work out suitable procedures which will ensure compliance with the intent of these requirements. Such work is necessary, and, if undertaken, will benefit everyone involved. Investment and maintenance costs should be reduced for the petroleum industry. The manufacturers will benefit by having a consistent standard. Application engineers will benefit because they will be able to select equipment with confidence that it meets the needs for their applications.

(Author's abstract.)

1758. Resistance of valves and fittings to fluid flow. Anon. *Oil Gas J.*, 17.6.57, **55** (24), 183.—A chart depicts valves and elbows, and shows how to determine resistance developed.

G. A. C.

1759. Determination of pump efficiencies from fluid temperature rise. G. P. Jennings and L. P. Meade. *Proc. Amer. Petrol. Inst.*, 1956, **36** (V), 36–9.—A new method has been developed whereby the temp rise in a pipeline pump can be measured and converted to h.p. loss and efficiency. The procedure is inexpensive and simple. Numerous tests have proved the accuracy of the method, which should be a valuable tool, not only to determine when to recondition a pump element but also as a check on the quoted efficiency of a new pump. (Authors' abstract.)

1760. Design of pulsation dampeners for high-speed reciprocating pumps. M. Ludwig. *Proc. Amer. Petrol. Inst.*, 1956, **36** (V), 47–54.—The primary purpose of the paper is to develop the necessary formulas for the design of a new type of pulsation dampener for use with high-speed reciprocating pumps. The novel feature of the design is that pulsations can be greatly reduced without the use of the usual, often troublesome, gas-filled chambers. It will be noted that, for economic reasons, the design is generally limited to pumps operating at relatively high speeds. Reasons why excessive pulsating pressures, with damaging pipe vibration, can occur in systems connected to high-speed multi-cylinder pumps are discussed; such vibrations have often been worse than with low-speed pumps, in spite of the more nearly uniform flow from high-speed pumps. Pressure pulsation records for several operating installations are included. (Author's abstract.)

1761. The engineering contractor's reaction to API Standard RP-500. J. T. Pringle. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 96–101.—The degree of hazard in the various parts of refineries can be quickly and precisely determined by following the criteria of API Standard RP-500. This has the immediate value of providing a uniform approach by engineering contractors, resulting in a co-ordinated installation based on sound principles and logical conclusions. The major differences between this method of classification and others encountered in the past, with their effect on electrical design, are developed in this paper. (Author's abstract.)

1762. The use of computers in petroleum refining problems. J. Sherman. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 217–19.—In order to produce gasoline, diesel fuel, and other products conforming to given specifications, various unit processes are used, such as dist, cracking, reforming, alkylation, and polymerization. At the outset it is not evident what schedule of operations should be carried out in a given refinery in order to produce the desired finished products most efficiently. Many alternative possibilities generally exist, and the most desirable one can best be determined by making a large number of calculations. In the past these calculations could not be carried out adequately because they are so extensive that the time involved would have been prohibitive. However, the use of a high-speed computer greatly increases the amount of computation which it is practical to perform. One important advantage of this is that it puts the refinery in a much better position to meet unexpected situations, such as equipment breakdown. Another advantage is that it liberates the process engineer from tedious desk computations, and so enables him to be more productive. (Author's abstract.)

1763. The design of heat exchangers on automatic computing equipment. A. M. Peiser. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 232–7.—Complete shell and tube heat exchangers on digital computing equipment are now being designed in a routine manner by the M. W. Kellogg Co. Limitations of present equipment have restricted the applications to single-phase, turbulent-flow fluids on both shell and tube sides. Within this area, a wide variety of designs have been carried out, encompassing any combination of hydrocarbons, water, or water soln as the heat-exchanging media.

The use of computers in this application has resulted in the following advantages: (1) the capacity to obtain additional information has been greatly increased; (2) the cost of thermal rating has been lowered; (3) peak work loads have been absorbed and required schedules more easily met.

A primary requirement for efficient computer utilization in design engineering is that the computer be able to carry out the calculations in an automatic fashion. This requires that all of the decision-making steps normally encountered in design be built into the computer programmes. The difficulties arising in this connexion are illustrated in terms of the tube-sheet layout problem. Some basic decisions made in the layout are discussed, and layouts obtained on the computer described. (Author's abstract.)

1764. Computers in refinery planning. R. G. Donovan and R. W. Schrage. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 244–8.—Automatic electronic computers have achieved a position of prominence as an aid to management decision making. This role is demonstrated by a description of how a computer can simulate the operations of a refinery. Supplied to the computer are data describing the crudes to be processed, estimates of processing conditions, product specifications, and raw material costs. From this information, the computer automatically finds a feasible manner for operating the refinery so that physical limitations and quality requirements are satisfied. The high speed and wide flexibility of this programme are demonstrated by reference to several economic studies in which it was used. (Authors' abstract.)

1765. The plant and future considerations. W. L. Bowser. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 55–6.—The author shows by means of curves that—for a plant built in 1955 to duplicate one built in 1945—the cost would be approx doubled. Charts show that—in a sp case—61 c of every ex-

pense dollar represents items which designer or operator has little chance to affect. The remaining 39 c could be improved by utilizing more highly skilled personnel at higher rates. Further charts, based on L.P.G. moved from W. Texas, show the distribution of the income dollar. Economies in transportation—pipelines—and other factors which could affect plant product value are discussed. R. T.

1766. Radial heat transfer in packed beds. S. S. Kwong and J. M. Smith. *Industr. Engng Chem.*, 1957, **49**, 894–903.—Radial temp profiles, and hence thermal conductivities, were measured in tubes packed with alumina and steel spheres. Values of K were found to decrease rapidly near the tube wall. Data may be used in the design of solid cat reactors, etc. D. B. S.

1767. Circulation cleaning with detergents. A. T. Thibadeau. *Oil Gas J.*, 24.6.57, **55** (22), 156.—A 6-year progress report is given on cleaning of 5 towers in a Louisiana plant's C_4 vapour recovery unit by acidic detergent. An inhibited detergent with solvent and acidic properties was finally developed and showed a saving of over 31% over the previous costs. G. A. C.

1768. The Dounreay Atomic Energy Establishment. Anon. *Petrol. Times*, 21.6.57, **61** (1562), 531.—Engineering aspects of interest to the oil industry are described, and include the fast reactor, the reactor vessel, heat exchangers and boiler plant, liq-metal pumps, electrical generating plant, control and instrumentation, and materials testing reactor. G. A. C.

1769. The scope and administration of preventive maintenance. C. C. Carmine. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 194–202.—A preventive maintenance programme in general provides for a system of scheduled inspection and maintenance of equipment which has been determined to be critical. The programme is successful if, through the prevention of unscheduled breakdowns of uncertain duration and seriousness, there results a decrease in operating costs, an increase in production, and added protection to capital investment.

The scope of a complete or ideal preventive maintenance programme should include consideration of the following elements: (1) design and material controls; (2) operating procedures; (3) records; (4) the extent of the programme; (5) the accounting system; (6) maintenance organization and procedures; (7) reports; (8) quality of personnel.

Tide Water Associated Oil Co, at its 110,000-b.d. refinery in Avon, California, located 30 miles E. of San Francisco, has adopted a portion of the ideal preventive maintenance programme and is administering it successfully.

This paper discusses what are considered to be the elements of an ideal programme and describes the administration of those phases which have been made effective at Avon.

Emphasis is placed on the necessity for including the technical man in the development and administration of such a programme. (Author's abstract.)

1770. Greece: refinery for lease or sale. Anon. *Petrol. Press Serv.*, 1957, **24**, 261–3.—Early in 1955 the Greek Government awarded the building of a 30,000-b.d. refinery near Athens to the German firm Hydrocarbon Mineralöl G.m.b.H. The plant is to start up in a few months time, but its future status and mode of operation are undecided. Tenders—to be in by 26 June—were invited, either for leasing the plant to an operator for his own account for 10 years, to to operate it on the Government's behalf, or for outright purchase. This unattractive proposition is offered under stringent conditions, and technical staff will be difficult to procure. The refinery, costing well over $20 million, will give a large yield of black products, its only ancillary facilities being a 230,000-ton Atlantic cat reformer, a bitumen plant, and a desalting unit. Future inland and bunker demand for fuel oil will not be wholly covered by the refinery, and there will be a surplus production of gasoline and kerosine. Greece's inland consumption of major petroleum products—now *ca* 1·4 million metric tons p.a.—is expanding only very slowly; gasoline trade has been declining. All oil supplies are now imported as finished products. A barter agreement provides for Russian deliveries of 400,000 tons of oil this year. Hydroelectricity and lignite production are being developed, and oil's share in energy consumption is expected to decline over the next few years. The search for oil continues. R. T.

DISTILLATION

1771. Annual survey of field-processing natural gasoline plants. Anon. *Oil Gas J.*, 29.4.57, **55** (17), 152.—Location, capacity, throughput, and product output of natural gasoline plants in the U.S.A. and Canada are listed. Total output was over 31 million gal/day 1 Jan 1957, an increase of 6·6% over the previous year. G. A. C.

1772. Ripple trays did the job. T. J. Harvey and A. J. Connell. *Oil Gas J.*, 3.6.57, **55** (21), 100.—The installation of Stone and Webster ripple fractionation trays in 5 columns at Canadian Oil Co's Sarnia refinery resulted in a 58% increase in crude capacity at a cost of *ca* ⅓ that of installing new capacity. G. A. C.

1773. Design for physical equilibrium. J. O. Osburn. *Chem. Engng*, 1957, **64** (4), 284–8.—3-component equilibrium data can be derived from 2-component data either mathematically or graphically. The graphical method, which consists of interpolating activity coeff on a triangular diagram, is discussed. A method is also described of calculating vapour–liq equilibrium compositions from b.p. measurements in ternary systems by a new correlation of vapour–liq equilibrium data. D. H. A.

1774. Economics of ethane recovery. H. H. Beeson. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 53–4.—Sales of C_2H_6–C_2H_4, C_2H_6–C_2H_6, and C_2H_6–CH_4 mixtures are discussed. Most plant residue gas sales are on a B.t.u. basis. Contract conditions and their important effect upon the economics of C_2H_4 recovery are discussed with an illustrative example. The main points to be considered relative to the plant are stated. R. T.

1775. Automatic rating of fractionators. J. C. Reidel. *Oil Gas J.*, 6.5.57, **55** (18), 103.—Major steps are outlined in a practical programme for plate-to-plate computations on a medium-speed computer, based on experience at Humble Oil Refining Co's Baytown plant. G. A. C.

1776. Fractionation taps new source of styrene. Anon. *Chem. Engng*, 1957, **64** (6), 160–2.—At the Cosden Petroleum Corpn's new $3-million, 20-million lb/year styrene plant at Big Spring, Texas, the process is based on the direct recovery of ethyl benzene from gasoline instead of the usual process involving alkylation of ethylene and benzene. Ethyl benzene is separated from a mixed xylene stream containing 25–30% ethyl benzene by fractional dist in 3 200-ft towers containing a total of 350 plates. The critical cut is based on a b.p. difference of only 2·3° C. 99·7% pure ethyl benzene is the product. D. H. A.

1777. New low-holdup high-efficiency laboratory distillation column. J. D. Ray. *Rev. sci. Instrum.*, 1957, **28**, 200.—A new type of dist column similar to a Vigneau column is described which has the indentations perpendicular to the wall of the tube. It was found that the indentations have optimum performance if at an angle of 90° to the axis of the column. A jig is described which facilitates making indenta-

tions in glass tubing so as to result in a high precision of indentation spacing. (Author's abstract.)

1778. Solution of multi-component distillation problems on a stored-programme computer. J. S. Bonner. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 238–43.—This paper presents a discussion of a completely integrated, flexible, and rigorous computer programme for the solution of multi-component dist problems. The programme is integrated in the sense that all initial assumptions, data conversions, preliminary and set-up calculations, adjustments, and terminal calculations are accomplished in a single computer run, without operator intervention. It is flexible, in that it will handle sharp as well as sloppy separations, and is capable of rewriting parts of itself in order to fit a wide variety of problems. It uses definitive and rigorous calculation techniques and includes such refinements as complete heat balances around each stage, evaluation of equilibrium and enthalpy data at true tray temp, and automatic feed-plate matching. A typical problem (40 plates, 15 components) may be set up and run in less than a day. Subsequent work-ups based on the same feed components would require negligible set-up time and less than 2 hr of computer time. This saving is noteworthy when compared to one or 2 months required when using a desk calculation. (Author's abstract.)

SOLVENT EXTRACTION AND DEWAXING

1779. Design for liquid–liquid equilibrium. J. O. Osburn. *Chem. Engng*, 1957, **64** (5), 276–84.—The principles of 3-component liq–liq equilibrium are reviewed. Equilibrium diagrams and their construction, the use of distribution diagrams, the occurrence of solutropes, and the way a good solvent should be selected are discussed. D. H. A.

CRACKING

1780. Distribution of metal contaminants on cracking catalysts. J. E. McEvoy, T. H. Milliken, and G. A. Mills. *Industr. Engng Chem.*, 1957, **49**, 865–8.—The deposition of nickel and vanadium on pelleted clay and synthetic bead cracking cat, in both commercial and pilot plant operation, was studied using both vapour phase and mixed phase feed operation. By removing peripheral surfaces from the cat it was found that up to 60% of the deposited metal was within 35 μ of the outer surface (= 5 wt % of the pellet) and 10% within 5 μ.

This distribution held over a wide range of metal content, and consequently, as metal contaminants cause serious decrease in cat selectivity, it is important to maintain max cat size. By so doing it is possible to eliminate a high proportion of the contaminants with the fines formed by normal rubbing attrition. D. B. S.

1781. Graphic method for the study of catalytic processes. H. J. Waterman. *Riv. Combust.*, 1957, **11** (5), 287–99.—It has been recently proved that the activity of a cat can be characterized by a certain number of parameters, according to a very simple principle of graphic tracing, in which the most important actions of the cat, namely, the conversion of the starting material, the formation of the derived products, and the formation of by-products, are considered.

According to this principle, many chemical processes, in which selectivity problems are involved, can be represented graphically as pseudo-ternary systems, of which the unconverted starting material A, the desired product B, and the by-products C are the components; the course of the reactions can be plotted in a triangular diagram. It has been found that in those cases the concn change of the 3 well-chosen components, as a result of the variation of one reaction variable, can be represented by an equation of the second degree.

$$y = \frac{x\,(1 - x)}{a + bx}$$

in which y and x represent the 2 co-ordinate lines of the triangular diagram, whilst a and b are constants. The performance of the cat under the conditions in question can therefore be characterized by 2 constants, a and b.

(Author's abstract.)

1782. Heterogeneous catalysis in petroleum chemistry. (In German.) A. G. Oblad and H. Heinemann. *BrennstChemie*, 1956, **37** (21–22), 359–63.—Conception of the nature of cat is discussed. The chemisorption theory has been broadened to bring it into harmony with the knowledge of surface heterogeneity. The modifications extend to assumptions that active spots actually exist on the surface, and that reactions between surface mol and reaction media produce an apparent heterogeneity on a homogeneous surface. Proof is sought by using isotopes. Better knowledge of the physics of solids has bound cat activity with the electron theory of the metals. Types of cat from the chemist's standpoint are: (1) strong acids and bases; (2) metal oxides, sulphides, and hydrides; (3) metals. The materials of each class are given, and cat activity explained with relevant theories. The 3 classes of cat are used widely in the petroleum industry. The most commonly used cat reactions and the cat producing them are presented in tabular form. Cracking, polymerization, isomerization, and H_2-transfer follow a carbonium-ion procedure and are catalysed by acid cat. Hydrogenation and dehydrogenation are catalysed through cpds which have an electron deficiency structure, *i.e.* metal oxides and metals. Cat of class 2 and 3 above promote reforming, hydrogenating-desulphurization, dehydrogenation, and cracking hydrogenation reactions. Cat may be bi-functional. On account of physical properties cat may be divided into liq, *e.g.* HF and H_2SO_4, and solids as porous particles. Pore space is important; hardness, d, and attrition are appropriate characteristics. Selectivity, eff loss, and cat poisoning are discussed. 21 lit refs. R. T.

1783. Cracking of hydrocarbons to ethylene. (In German.) H. Pietsch. *Erdöl u. Kohle*, 1956, **9**, 453–6.—The equilibrium const for pyrolysis of C_2H_6, C_3H_8, C_4H_{10}—assuming the primary reaction—furnishes information on the product quantity—given in mol % and wt %—resulting from fission at different temp. Equilibrium const were calc for fission of paraffins to naphthenes and aromatization of the latter. Failure to attain the calc equilibrium val generally in the fission is attributable to excessively long reaction times. Olefins formed in the primary reactions crack further to very stable CH_4 or polymerize to aromatics. Pressure increase displaces the equilibrium towards the feedstock side or to *sec* reactions. Heat transfer to the feedstock to be cracked plays an important part. Mobile heat carriers—pebbles, sand, etc.—are shown to be superior to the conventional carriers—tubular heaters, towers, etc.—as regards max ethylene yields. Small heat drop within the cracking chamber, good heat transfer to the oil feed, with short contact times and high temp, are necessary for optimum ethylene yields. 11 refs. R. T.

1784. Regenerative platinum—catalyst reforming successfully produces modern premium fuels. H. C. Nix. *Oil Gas J.*, 20.5.57, **55** (20), 168.—2 years operating the process at Humble Oil and Refining Co to produce high-octane requirements on 2 20,000-b.d. units using a Standard Oil Co developed platinum-on-aluminium cat show method successful and produces higher gasoline yield. G. A. C.

1785. Cat cracking with kaolin catalyst. D. Beyler, J. D. Maerker, and J. W. Schall. *Oil Gas J.*, 3.6.57, **55** (22), 95.—

Advantages over bentonite clay and synthetic cat are discussed, together with its steam and thermal stability and regenerability. G. A. C.

1786. Commercial two-stage fluid cracking—a new technique. J. D. Heldman, F. Kunreuther, J. A. Marshall, and C. A. Rehbein. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 258–64.—New techniques have been developed in fluid cat cracking to provide higher gasoline and lower coke yields and greater flexibility than conventional operation. Attention has been directed to reaction, stripping, and regeneration. Process development has ranged from lab experiments through pilot plant development and full plant scale engineering studies.

The first commercial unit employing these new techniques recently came on stream at Shell Oil Co's new refinery at Anacortes, Washington. Early operation has confirmed the predicted benefits. At Anacortes virgin feedstock is first contacted with cracking cat in a riser reactor, *i.e.* a pipe in which fluidized cat and vaporized oil feed flow concurrently upward. Total contact time in this stage is short, in the order of seconds. High temp are employed to reduce undesirable coke laydown on cat without destruction of gasoline by secondary cracking. All or part of the unconverted or partially converted gas-oil product from the first stage is then cracked further in a fluid bed reactor. By varying conditions in the 2 cracking zones, wide operating flexibility is obtained for shifting from max gasoline to max intermediates production.

The underlying principles developed by Shell can also be applied in arrangements other than those used at Anacortes. For example, a single-stage riser reactor unit can be advantageously used to reduce coke make in cases where high conversion is not required. The techniques can be adapted to existing fluid units in some cases as, for example, by adding a riser reactor first stage and other auxiliaries.

(Authors' abstract.)

1787. Koppers–Hasche pilot plant producing natural gas substitute and low heating value gas. J. F. Farnsworth, G. M. Bretz, and G. V. McGurl. *Industr. Engng Chem.*, 1957, **49**, 404–9.—A Koppers–Hasche furnace was used to reform a high methane natural gas and propane to gases of low heating value and high hydrogen content suitable for blending for city use. The process, which works on a cyclic, non-cat principle, is described and the optimum operating conditions discussed. Max efficiencies were obtained at low space velocities of 600–700 (vol of feed/vol free space reaction zone/hr) and at the fairly high reaction temp of 2500° C. It was found that heating requirements amounted to *ca* 25% of the feed requirements for the reforming, and that the carbon leaving in the gas (usually 3–4% by wt of the feed) could be easily removed. D. B. S.

1788. Blitzing alkylation problems. 4. Four upkeep problems are solved. L. Resen. *Oil Gas J.*, 13.5.57, **55** (19), 143.—This part deals with fouling of reboilers, removal of " rag " in water settlers, keeping tube bundles clean, and loss of seal oil due to power disruption. G. A. C.

1789. Molybdenum in petroleum refining. 2. B. H. Danziger and J. R. Milliken. *Petrol. Engr*, 1956, **28** (13), C12–15.—Initially a number of reforming processes using molybdenum, namely, fixed-bed hydroforming, fluid hydroforming and orthoforming, and hyperforming, are discussed. The versatility of molybdenum in alkylation, isomerization, polymerization, and oxidn reactions is also mentioned. Other uses of molybdenum as lubrication additive and in the production of corrosion-resistant alloys are considered. E. A. G. H.

1790. Pentane dehydrogenation. H. Shalit, F. W. Kirsch, W. S. Briggs, and J. B. Maerker. *Oil Gas J.*, 20.5.57, **55** (20), 150.—A process study of cat pentane dehydrogenation shows that octane ratings of pentane can be substantially increased, process is more flexible in being able to utilize a wide range of feeds, but yields are smaller. 4 tables are given. G. A. C.

1791. This reforming process is different. Anon. *Chem. Engng*, 1957, **64** (4), 152–4.—A new hydrocarbon reforming process which produces H_2-rich fuel gas or synthesis gas by continuous autothermic cat from a range of hydrocarbon gases or liq is described. Its advantages include flexibility, low investment cost, 97–99% thermal efficiency, simple continuous operation adaptable to automation, and quick start-up and shut-down. D. H. A.

1792. Platforming—a progress report. V. Haensel and D. H. Belden. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 275–80.—Since its introduction 7 years ago the Universal Oil Products Co Platforming process has become an important factor in supplying the demand for premium fuels. This paper describes the current commercial status of the process and the theoretical background in the development of improved cat, which are to be utilized in the production of fuels with still higher O.N. The commercial experience with both the standard and the new Platforming cat at higher octane levels is presented. (Authors' abstract.)

1793. Catforming for high octanes in Canada. H. R. Grane and J. A. Nevison. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 252–7.—The trend of change in gasoline-octane quality in Canada is reviewed with respect to the increasing cat reforming capacity being installed there. Over ½ of this capacity is in Catformers now in operation or under construction. Yield octane results being obtained in operating units are described. Looking ahead to the production of 100 O.N. premium fuels, the authors discuss techniques for achieving this goal with minimum capital outlay and operating expenses. Examples illustrating moderate-severity Catforming and separation of high-octane heavy Catformates for use in blending 100 O.N. premium gasolines are included. Cat developments permitting 95–100 O.N., clear, Catformate production from Middle East naphtha in conventional commercial units are illustrated. (Authors' abstract.)

1794. Ultraforming to 100 octane, clear. P. C. White, W. F. Johnston, and W. J. Montgomery. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 265–74.—Gasoline of 100 Research O.N., clear, has been consistently produced on American Oil Co's 21,200-b.s.d. Ultraformer at Texas City, Texas. The Ultraforming process is a fixed-bed, multi-reactor reforming process, employing a platinum-on-alumina cat. By operating at lower pressures than those used in other reforming processes, greater yields of high-octane gasoline are obtained. Cat activity is maintained by cyclic regeneration while the unit remains on stream.

The American Oil Co Ultraformer charges a 400° F end-point virgin naphtha. 2 major problems were encountered in the early unit operation—cat attrition and hydrogen-sulphide corrosion. Since the elimination of these difficulties the unit has operated very satisfactorily. After over a year of operation the cat has undergone an average of 65 regenerations per reactor. The present cat life is expected to be at least 60 brl/lb. Gasoline yields duplicate the yields predicted by pilot-plant operation.

Pilot-plant studies have been carried out to establish yield–octane relationships for a variety of naphthas. These data further illustrate the high yields of 100 O.N. reformate available through Ultraforming.

With direct operating costs of 25 cents/brl, Ultraforming represents an economical route to 100 O.N. reformate, clear. (Authors' abstract.)

X

HYDROGENATION

1795. Catalytic liquid phase hydrogenation. R. H. Price and D. B. Schiewetz. *Industr. Engng Chem.*, 1957, **49**, 807–12.—Cat liq-phase hydrogenation in a semiflow process was investigated on a lab scale and the effects of cat and reactant concn, pressure, rate of stirring, stirrer design, flask shape, etc., on the rate of reaction studied. The rate was found to be controlled by the mass transfer of hydrogen from the bulk of the soln to the cat–liq interface. Hydrodynamic factors appear to be important in stirred systems, and should be more fully investigated. D. B. S.

POLYMERIZATION

1796. Isotactic and other stereoisomeric polymers. G. Natta. *Chim. et Industr.*, 1957, **77**, 1009–31.—New classes of linear macromolecules, characterized by regular steric structures, have been obtained by synthesis, through new stereo-specific processes of catalysis; crystalline isotactic polymers, in which tertiary carbon atoms in the main chain offer the same relative steric arrangement; syndiotactic polymers, in which each tertiary carbon atom offers the opposite steric arrangement to that of neighbouring tertiary atoms. Data are reported on the crystalline structure and on the main technical properties of the crystalline isotactic polymers of α-olefins, and especially of polypropylene, which is marked out for important practical applications in the plastics and textile fields. The atatic polymers (with irregular steric arrangements) with a very high mol. wt., and the recently discovered polymers with "stereoblocks," with low crystallinity, have interesting elastomer properties. In the field of polydiolefins, the new stereo-specific polymerization processes have made it possible to produce new polymers, among which all the theoretically predictable stereoisomeric crystalline polymers of butadiene: 1-4 (*cis*), 1-4 (*trans*), 1-2 (*isotactic*), 1-2 (*syndiotactic*). (Author's summary.)

1797. Ethylene polymerization by the Ziegler process. X. Thiese. *Bull. Ass. franç. Tech. Pétrole*, 1957, 103–14.—Lecture; background to process and work on organo-aluminium cpds outlined and mechanism of polymerization discussed. Thermal and mechanical properties of low- and high-pressure products are compared, the former is more highly crystalline, more resistant to heat, and more easily workable. Possible uses of low-pressure polyethylene are indicated. V. B.

ALKYLATION

1798. Blitzing alkylation problems. 5. Tips on handling unit charge. L. Resen. *Oil Gas J.*, 3.6.57, **55** (32), 93.—Problems concerning operation with amylene charge and to reduce turnround time, increased C_3 charge, and converting alkyl feed-preparation unit are discussed. G. A. C.

ISOMERIZATION

1799. Isomerization adds to your octane picture. H. R. Grane, J. K. Ozawa, and G. R. Worrell. *Oil Gas J.*, 20.5.57, **55** (20), 157.—Conversion of *n*-pentane and *n*-hexane to their isomers increases octanes substantially, and thus provides a component with very high road anti-knock properties for super-premium fuels. Data are presented on *n*-hexane isomerization and to show how C_5 and C_6 pentafining should be installed in a typical refinery. G. A. C.

CHEMICAL AND PHYSICAL REFINING

1800. Sweetening natural gas with ethanolamine solutions. H. G. Mohlbauer and P. R. Monaghan. *Oil Gas J.*, 29.4.57, **55** (17), 139.—Data are given for accurate design and operation of gas treating plants. G. A. C.

SPECIAL PROCESSES

1801. Vapour pressure of phosphoric acid at high temperature and pressure. A. E. Handlos and A. C. Nixon. *Industr. Engng Chem.*, 1956, **48**, 1960–2.—An equilibrium bomb for the determination of cat-reactant equilibrium at varying temp and pressure is described. The bomb, in which the cat is weighed at operating conditions on a torsion pendulum balance, may also be used to determine the apparent surface area of the cat under operating conditions. D. B. S.

1802. Difunctional acids by petroleum hydrocarbon oxidation. C. N. Zellner and F. Lister. *Industr. Engng Chem.*, 1956, **48**, 1938–48.—Petroleum hydrocarbons have been cat oxidized in the liq phase in lab and pilot-scale plants. The primary oxide products were found to be difunctional acids, and they showed promise in the replacing of more costly dibasic acids for use in alkyd resins, polyesters, plasticizers, and other applications requiring a difunctional mol. Reaction variables and optimum conditions are discussed and mechanisms for the reaction suggested. D. B. S.

1803. Processes for synthesis of aromatic hydrocarbons from petroleum. C. Thonon. *Rev. Inst. franç. Pétrole*, 1957, **12**, 218–39.—The rapidly increasing demand for aromatics, both as pure cpds and as components of high octane petrol, has led to their synthesis from paraffinic and naphthenic cpds present in petroleum. Consideration of the thermodynamics of the reactions indicates that 2 processes are possible, thermal and cat aromatization. As examples of thermal cracking processes for the production of aromatics the Catarole and Thermofor Pyrolitic processes are briefly described. More important, however, because of their greater selectivity, are cat reforming processes. Their development is surveyed, and factors governing the choice of cat discussed. Dehydrogenation of naphthenes must be suppiemented by dehydrocyclization of paraffins, thus requiring cat of multiple function and leading to the development of the newer processes of Rexforming and Iso+, in which an intermediate extraction stage is followed by further reforming of the paraffinic concentrate. Poisoning of Pt reforming cat is avoided by preliminary removal of S, N, As, etc., using Co molybdate as cat. Such pretreatment is avoided in those reforming processes which use oxide cat, but provision must be made for their continuous regeneration. Simplified flow diagrams of the Platforming, Ultraforming, Rexforming, and Orthoforming processes are given, and brief details of all the main reforming processes are tabulated. Finally methods of extracting aromatics from the reformate are mentioned. W. A. M.

1804. Control of pure aromatic oxy-compound production from crude acid mixtures from low-temperature-carbonization-coal tar for manufacture of phenol–formaldehyde synthetic resins, using laboratory packed columns. (In German.) A. Jäger and G. Kattwinkel. *BrennstChemie*, 1956, **37** (21–22), 372–4.—Accurate lab analyses preceding each operation simplify continuous processing of crude acid mixtures from low-temp-carbonization tar. Optionally, pure products or specially prepared mixtures can be used directly in phenol–formaldehyde synthetic resin production. By continuous operation the numerous intermediate fractions are avoided; max yields of high-purity components separated from the crude acid mixtures are obtained. Time is saved by using the i.r. spectrograph instead of packed columns. By continuous vac fractionation oxy-cpds in the boiling range 220°–300° C can be obtained. R. T.

1805. Measuring solids concentration in fluidized systems by gamma-ray absorption. R. N. Bartholomew and R. M. Casagrande. *Industr. Engng Chem.*, 1957, **49**, 428–31.—A method whereby the density distribution of the solids in a fluidized system may be measured by a γ-ray absorption technique is

described. The equipment is mounted externally and does not, therefore, interfere with the process.

The Lambert–Beers equation was used to develop an equation relating the average density along any path to the path length, mass absorption coeff, and radiation intensity under flow and non-flow conditions. The density distribution may be obtained by graphical or analytical methods using this equation. D. B. S.

1806. Changes in iron catalysts and the Fischer–Tropsch synthesis. K. C. Stein, G. P. Thompson, and R. B. Anderson. *Industr. Engng Chem.*, 1957, **49**, 410.—3 samples of iron cat —a precipitated iron and copper oxide–potassium carbonate cat, and both reduced and nitrided samples of a promoted fused iron oxide cat—were used in a Fischer–Tropsch synthesis for periods of 2–7 weeks, and the subsequent surface area and pore and total vol measured. The precipitated cat was found to have virtually no surface area or pore vol. The total vol of the reduced cat increased, but the pore vol and surface area was almost zero, due to wax in the pores and oxide. Nitrided cat had a small pore vol and surface area, but the total vol was relatively large. Mechanisms for the changes are suggested. D. B. S.

METERING AND CONTROL

1807. Development and application of automatic devices for crude oil measurement. M. H. Atkinson and A. H. Newberg. *Proc. Amer. Petrol. Inst.*, 1956, **36** (V), 40–3.—Talk of automation of petroleum industry operations is heard constantly today, and the increase in petroleum demand also increases the economic incentive for more efficient means of measuring, sampling, and testing crude oil. This paper is a progress report on some of the development and application of automatic measuring, sampling, and testing equipment to current crude oil operations in an effort to better acquaint all concerned with results being obtained as compared to accepted standards of manual measurement methods and equipment. Since new equipment developments are appearing almost daily, it is difficult to conclude what to-day's results mean. The evidence does show, however, that automatic measuring devices are being accepted in daily operations and they can do a more accurate, efficient, and dependable job when properly applied, installed, and maintained.

(Authors' abstract.)

1808. Information for plant management. A. F. Sperry. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 130–7.—Broader application of feedback-control principles through automatic information handling can reduce raw material and capital costs and appreciably increase overall refinery productivity. Very little feedback is found in most refineries and processing plants to-day except at the lowest echelons of operations, *i.e.* automatic control of process variables. Improved data processing, coupled with broad improvements in measurement, can break down the time barrier to effective closed-loop control at the operator, technical staff, and management levels. Computers will play an essential and ever-growing part in the control of cycle, but will not replace man as the decision maker. A general purpose information system (including off-normal scanning, automatic process logger, computer, tape punch, and universal measuring system) and a special purpose system (tank-farm accounting system) which can help all levels of management are described.

(Author's abstract.)

1809. Factory-built L.A.C.T. unit is gas operated. R. W. Hill. *Oil Gas J.*, 6.5.57, **55** (18), 98.—Pan American Petroleum Corpn's lease-automatic-custody-transfer unit operating in S. Oklahoma is described; it is factory made, pneumatically-controlled, simple in design, and of low cost. G. A. C.

1810. B.S. and W. control in automatic custody transfer. H. J. Endean. *Petrol. Engr*, 1956, **28** (12), B24–6.—A monitor device comprising capacitance-sensitive instruments determines whether the basic sediment and water content being delivered from the separator or treating equipment to tankage exceeds B.S. and W. specification, in which case it is rerouted to wet oil storage. The monitor is adaptable to any process where changes in dielectric constant of fluids are suitable for control purposes. E. A. G. H.

PRODUCTS

CHEMISTRY AND PHYSICS

1811. Calculation of the equilibrium composition in C_6 hydrocarbon–hydrogen systems. E. B. Weinberger and C. W. Montgomery. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 220–8.—The method developed by Brinkley for calculating the equilibrium composition of multi-component systems is discussed with particular reference to the C_6 hydrocarbon–hydrogen system. A modification of the method is proposed, which permits convenient solution by the use of a digital computer. It is shown that the problem reduces to the solution by iterative methods of a fifth-order algebraic equation. The programming of the problem is outlined, and a flow diagram of the calculations is given. More than 50 different hydrocarbons were included in the calculations, which were carried out at 99 different sets of conditions corresponding to temp of 700°, 800°, and 900° F; pressures of 8, 16, and 32 atm; and hydrogen–hydrocarbon mol feed ratios from 0 to 1·0 in 0·1 increments. Results of the calculations are presented graphically. Over these conditions the equilibrium composition changes from a predominantly isoparaffinic to a predominantly aromatic product. It is shown that the effects of variation in temp pressure, and hydrogen–hydrocarbon feed ratio on the equilibrium concn of hexenes and naphthenes are rather unexpected and could probably not have been predicted without considering the complete C_6 system.

(Authors' abstract.)

1812. Microphotographic method of observation of atomized jets. S. Chadeyron, A. Combe, and H. Guénoche. *Rev. Inst. franç. Pétrole*, 1957, **12**, 240–7.—Microphotography can provide much useful information about droplets in an atomized jet. If the jet is rather dense, however, the statistical distribution of the drops as a function of their dia cannot be obtained under practical conditions. A detailed analysis of the optical system used reveals the reasons. W. A. M.

1813. A new still and method for determining vapour–liquid equilibrium. B. G. Harper and J. C. Moore. *Industr. Engng Chem.*, 1957, **49**, 411–14.—A new modification of the conventional recirculation type of still is described. Equilibrium data may be measured without analysing vapour and liq samples provided that the weight and composition (determined by referring to a previously constructed b.p.–composition curve) of the liq phase is known before and after a sample of vapour has been taken. Data for 2 systems compare well with other authors. D. B. S.

1814. Linear boiling point relationships. Y. Ogata and M. Tsuchida. *Industr. Engng Chem.*, 1957, **49**, 415–17.—A linear b.p. relationship was observed amongst various series of simple aliphatic cpds (RX). The b.p. may be found from the equation $t = py + q$, where p and q are constants depending on the functional group X, and y is a constant which varies with the alkyl group R. Values for p, q, and y are given.

The equations have been applied to 600 cpds and the calculated results for 80% of them fell within 2° C of experimental values. Reasons for the discrepancies are discussed.
D. B. S.

1815. Direction of the friction force. E. Rabinowicz. *Nature, Lond.*, 1957, **179**, 1073.—Although for most purposes the friction force may be assumed co-linear with the sliding direction, experiments indicate that a transverse force operates at right angles of magnitude between 1·7 and 5% of the ordinary friction force. These values indicate that the friction force diverges between 1° and 3° from the sliding direction.
H. C. E.

1816. Experimental study of a method of vapour entrainment by a gas. A. Combe *et al.* *Rev. Inst. franç. Pétrole*, 1957, **12**, 330–8.—Description (sketch) of thermostatted glass lab carburettor. Instrument was tested with 3 liq (acetaldehyde, propionaldehyde, acetone) and effect of change of variables on amount of entrained liq studied. Instrument gives desired constancy of gas mixture comp over reasonably wide range of flow rate (carrier gas below 5 mg/sec) and duration, and comp is a direct function of the v.p. of the entrained liq.
V. B.

1817. Rapid compression machines. A. Combe, H. Guénoche, and C. Meyer. *Rev. Inst. franç. Pétrole*, 1957, **12**, 338–53.—Bibliographical survey of adiabatic high-speed compression machines, designed for lab reaction studies, especially hydrocarbon oxidn such as occurs in spark ignition engines. Several machines are illustrated and described, and the results obtained therewith are discussed with regard to their bearing on engine knock problems.
V. B.

1818. A simple equation of state for CO–H_2 gaseous mixtures. A. di Cio. *Riv. Combust.*, 1957, **11** (5), 300–7.—The following equation of state for CO–H_2 gaseous mixtures is proposed:

$$p = \frac{RT}{2c}\left(-1 + \sqrt{1 + \frac{4n_1 c}{V - B}}\right) + \frac{n_2 RT}{V - B} - \frac{A}{V^2}$$

where $\log c = \frac{440}{T} + 4{\cdot}315 \log T - 0{\cdot}0033\ T - 12{\cdot}655$

$$B = 0{\cdot}0443\ n_1 + 0{\cdot}016\ n_2$$
$$A = 0{\cdot}42\ n_1^2 + n_1 n_2$$

(units: litres, atmospheres, ° K)
and where n and n_2 stand respectively for the number of mol of CO and H_2 contained in the vol V of the mixture. In the range of available experimental data (1–400 atm, 33–67% H_2, 25° and 0° C isotherms) the discrepancy between calculated and measured pressures rarely exceeds 0·5% and is on the average 0·32%. (Author's abstract.)

ANALYSIS AND TESTING

1819. Some high-pressure properties of model substances and petroleum hydrocarbons. E. Kuss and G. R. Schultze. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 101–17.—The visc of 2 linear dimethyl–siloxane polymers (mean mol. wt. 8800 and 30,500) and of several esters of ortho-silicic acid have been determined at 25°, 40°, 60°, and 80° C up to 2000 kg cm^{-2} pressure. For high polymer silicone oils the visc depends strongly upon chain length, but visc dependence upon pressure is almost independent of the polymerization degree within the region investigated. The pressure dependence of visc increases greatly with chain length for esters of *ortho*-silicic acid in a manner analogous to that found for hydrocarbons. Ring groups within the mol exert considerable influence upon the pressure–visc relation. The system acetic acid–water was investigated as being representative of a chemically well-defined mixture with a visc max at a definite concn. As the pressure increases the visc max becomes more pronounced. However, the pressure coeff α of the relation $\eta_p = \eta_0 e^{\alpha p}$ shows no extreme val, max or min, within the entire concn scale. For the system *n*-butylalcohol–decahydronaphthalene, which is representative for a mixture with a visc min at a definite concn, coeff α does not reach an extreme val over the entire concn range. Polished metal surfaces which were exposed to pressures up to 10,000 kg cm^{-2} under oil showed quite characteristic structural changes following a sudden pressure release. The effect was verified in several ways using a metallographic and an electron microscope. The surface roughening was confirmed with a Forster–Leitz surface tester. Arc spectrograms proved that metal particles had been ejected from the metal into the ambient liq. This effect is more pronounced with alloys than with pure metals. No conclusive explanation of this phenomenon has been presented up to now, but several possibilities are discussed.
R. T.

1820. Automatic apparatus for sulphur estimation by combustion in a quartz tube. (In French.) E. Weisang. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 299–306.—An apparatus—developed in the lab of the Compagnie Française de Raffinage—for S estimation in hydrocarbons, is described. The operation—controlled combustion in a quartz tube—is rendered entirely automatic and independent of the operator by heating the sample to be analysed at a pre-established rate in a controlled air supply. Results obtained are more accurate than those specified by IP standards.
R. T.

1821. Practical, accurate index for estimating the viscosity–temperature behaviour. (In German.) J. Cornelissen and H. I. Waterman. *Erdöl u. Kohle*, 1956, **9**, 456–8.—The chief objection to the V.I. is accepting the linearity of the visc–temp relation. This relation is linear only when the temp scales of the test oil and the 2 reference oils are alike, *i.e.* if the 3 oils show the same val of const x from the equation: $\log \nu = \frac{A}{T^x} + B$, where ν = kin. visc (cS), T = abs temp (° K), A, B, and x = const. The "Fundamental Visc–Temp Index" F.V.T.I. does not show this disadvantage. The F.V.T.I. of a liq is defined as the difference between the logs of its visc at 2 temp: F.V.T.I. = $\log \frac{\nu_{20}}{\nu_{70}}$. The F.V.T.I. val of different liq are comparable only if they belong to one liq group, *i.e.* with the same x val, or if the x val of the test liq does not deviate by more than 0·5 from the average val x of the group of liq in question.
R. T.

1822. A new method for continuous gas analysis. (In German.) G. M. Schwab and O. Neuwirth. *Chem. Ing. Tech.*, 1957, **29**, 345–7.—The method described consists of measuring the pressure drop of the gas flowing through a number of identical capillaries in series; between successive capillaries, arrangements are made for the absorption of one component. Details are given of the analyses of 3-component mixtures by the use of this apparatus.
P. J. K.

1823. A look at vapour-phase chromatography. C. C. Helms and S. Noren. *Oil Gas J.*, 29.4.57, **55** (17), 146.—10 prototype vapour fractometers are described, developed by Perkin–Elmer Corpn, Connecticut. 7 of the instruments are now in the field working on actual plant problems, and 3 will soon be field tested, in continuous analysis and process control operations.
G. A. C.

1824. Vapour phase partition chromatography. II. P. E. Moghadame. *Rev. Inst. franç. Pétrole*, 1957, **12**, 58–66.—(*Cf.* Abs. **1159**, 1957.) Description and sketch of apparatus constructed by I.F.P., detection is by thermal conductivity cell (constructional details and circuit diagram given), thermal conductivity and temp coeff thereof of numerous products are

tabulated; results of hydrocarbon separations on columns using DNP and eicosane as stationary phase are shown. V. B.

1825. The quantitative method of gas chromatography. (In German.) H. H. Hansdorff. *Chem. Z.*, 1957, **81** (12), 392–6.—The technique of gas phase chromatography is reviewed, and particular emphasis is given to methods for the measurement of the areas, and the height of the peaks, on the chromatogram. Possible errors due to temp, and the velocity and pressure, of the carrier gas are also discussed. P. J. K.

1826. Some instruments and instrument techniques in use at the Safety in Mines Research Establishment. C. A. A. Wass. *Instrum. Pract.*, 1957, **11**, 585–98.—Includes section critically reviewing instruments available for estimation of small quantities of CH_4 in air under mining conditions. The main types involve combustion of the CH_4 at a Pt or Pd filament, and either measurement of the pressure drop or of the out-of-balance current when the filament forms part of an electrical bridge circuit. In Germany and Japan interference methanometers are used; these depend on n differences. W. A. M.

1827. Apparatus for viscosity determinations. W. Cooper and R. K. Smith. *Chem. & Ind.*, 1957, 936–7.—Descriptions are given of methods for permanently mounting and for cleaning U-tube viscometers. W. A. M.

1828. Distillation apparatus for moisture determination. T. Barr and J. I. Yarwood. *Chem. & Ind.*, 1957, 803–5.—Apparatus is described in which the water dist is led from a receiver into a calibrated capillary tube by means of a siphon, and all glass surfaces are coated with water-repellent silicone polymer. Details of apparatus preparation and use are given. Accuracy is claimed to be better than with a 10-ml Dean and Stark apparatus, and there are other advantages. W. A. M.

1829. Field tests for toxic substances in industrial atmospheres. B. E. Dixon. *Instr. Pract.*, 1957, **11**, 598–601.—A discussion of the basic requirements for sampling and testing for toxic substances in industrial atm under field conditions. W. A. M.

1830. Device for measuring friction. J. L. Lauer and P. J. Friel. *Rev. sci. Instrum.*, 1957, **28**, 294.—The sample can be moved horizontally by a manually-operated kinematic slide. A stylus resting on the surface is connected via an Al bar and the iron core of a differential transformer to a leaf spring. Voltage changes induced in the secondary transformer winding are prop to the tangential force applied to the sample surface, and are amplified and measured. The apparatus is calibrated by applying known weights to deflect the spring, and its sensitivity can be varied by adjusting the amplifier gain. Its range can be altered by using springs of different materials. H. C. E.

1831. Volatility, viscosity, and V.I. improvers affect oil consumption strongly. R. L. Overcash, W. Hart, and D. J. McClure. *Petrol. Engr*, 1956, **28** (12), C46–8.—Data are presented graphically from lab oil consumption tests, using a 6-cyl L-head engine over 6 hr. E. A. G. H.

CRUDE OIL

1832. Simplified analyses of several French crude oils. P. Picard and Y. L. Gladel. *Rev. Inst. franç. Pétrole*, 1957, **12**, 207–17.—Using the IFP method previously described (*cf.* Abs. **1326**, 1955) analyses were carried out on 4 recent discoveries, El Hodna (Algeria), Mothes 1 (Landes), Reiningue (Alsace), and Haguenau (Alsace). Results are presented in tabular form, together with results on a Middle East crude (Zubair) for comparison. U.S. Bur. Min. classifications (*cf.* Abs. **51**, 1936) were also made on all except the Algerian crude, the key fractions of which could not be obtained because of thermal decomposition. W. A. M.

GAS

1833. L.P. gas—a review and a forecast. J. W. Martin. *Proc. 35th Ann. Conv. Nat. Gas Ass. Amer.*, 1956, 95–9.—Earlier experiences in the LPG business, its growth and development over the years, and its future are discussed. The ever-present threat of natural gas in important desirable LPG markets, and the battle for survival against constantly cheapening electric energy—LPG's toughest competitor—are discussed. Figures presented analyse the unfavourable position of LPG compared with coal in rail rates and charges. R. T.

1834. Liquefied gas. (In German.) E. Boye. *Chem. Z.*, 1957, **81** (11), 361–2.—The composition, physical properties, and use of liquefied gas are discussed. Production of liquefied gas in Germany was expected to rise by 20% in 1956. In 1955, 40% of the liquefied gas made in Germany was used as a motor fuel. It has an octane rating of 100 and a weight advantage. (1 kg gas is equivalent to 1·4 kg petrol.) P. J. K.

1835. Electric strength of unsaturated hydrocarbon gases. R. W. Crowe and J. C. Devins. *Nature, Lond.*, 1957, **179**, 976.—For alkanes and *cyclo*paraffins the electric breakdown strength and the elastic cross-section (θ) are related by the expressions $\alpha/p = A(E/p)\exp(-BP/E)$, where α is the first Townsend coeff, E is the field strength, p the pressure, A is constant, and $B/\varepsilon^{1.5} = k\theta$, where ε is the first ionization potential and k is constant. Further, $\theta = \Sigma n_{C-X}\theta_{C-X}$, where n is the number per mol of bonds of the type $C–X$. A plot of $B/\varepsilon^{1.5}$ *versus* n_{C-H} gives parallel straight lines for mono-olefins and alkanes. If θ_{C-C} is zero for olefins and alkanes alike, then k is the same for both olefins and alkanes, and in both series the addition of a CH_2 group produces a constant increment in cross-section. Since the intercept for the olefins is not zero, $\theta_{C=C}$ cannot be zero, and this may be attributed to: (1) decrease in the shielding effect of the C–H bonds, and (2) the larger spatial configuration of the π-electron orbitals.

Using a value for $\theta_{C=C}$ calculated from mono-olefins, measured values of $B/\varepsilon^{1.5}$ for butadiene and benzene lead to values of $n_{C=C} = 2{\cdot}8$ and $3{\cdot}6$ for the diene and triene respectively. H. C. E.

1836. Accurate measurement of gas solubility. M. W. Cook and D. N. Hanson. *Rev. sci. Instrum.*, 1957, **28**, 370–4.—An apparatus and a technique accurate and reproducible to 0·1% have been developed for measuring the solubility of gases in liq. It is claimed that measurements are accurate to at least ±0·1%; as an example the solubility of H_2 in *n*-heptane at 35° C is given. H. C. E.

1837. Examination of usefulness of Polish activated carbon for recovery of gasoline from natural gas. M. Martynek. *Prace Instytutu Naftowego*, 1956, Series A and B, No. 42, 1–10.—Polish stabilizers use a mixture of activated carbons, mostly of Czech and Hungarian origin. Since these are not always available, an investigation has been carried out into the possible suitability of carbon especially prepared by the Central Institute of Mining at Hajnowka works. Lab- and large-scale tests were carried out using the Hungarian carbon as control. The lab work was concerned with destructive tests on the carbon to find its mechanical properties and absorbent power and limits, *i.e.* the breakthrough point, whilst the large-scale experiments were designed to discover the day-to-day behaviour of the material under working conditions; for this purpose samples were collected at regular intervals. All these tests showed that whereas the breakthrough point of the

Polish carbon for benzene is too low, it is quite satisfactory for propane. Polish carbon is harder and lasts longer in the stabilizer. After 40 days and after approx 140,000 cu. m. of natural gas has been passed through each, Polish carbon showed the better mechanical and absorbent properties, and the total yield of gasoline from it was approx 19,500 kg against 16,500 kg from Hungarian carbon. Also for extraction of iodine from water Polish carbon is superior. M. S.

1838. The manufacture of town gas from liquid or gaseous fuels. E. J. Lawton. *J. Inst. Fuel*, May 1957, **30** (196), 242.—The reasons for the increasing use of petroleum products for the manufacture of town gas in Europe are discussed, together with the possible sources of these products and types of raw material most likely to be available. The types of reaction used to convert a liq or gaseous product into gas of acceptable characteristics and their practical application are described. Specific processes considered are Segas, Hercules, and Semet–Solvay. 17 refs. D. K.

ENGINE FUELS

1839. Practical design of better fuels—a statistical approach to road performance studies. F. D. Buerstetta *et al. Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 149–61.—As new processing methods are employed by refiners to produce gasolines of higher and higher Research O.N., the incentive for achieving max road anti-knock performance with a given lab specification continues to increase. Recently British American Oil Co. Ltd and Ethyl Corpn conducted a joint programme designed to investigate the road anti-knock blending possibilities of gasoline components from a given refinery. Details of this study—including data, results, and particulars of programme design, execution, and analysis techniques—have provided the basis for this paper. The blending generalizations resulting from this study are described in detail.

As originally carried out, the joint programme comprised the testing, in 3 vehicles of 60 experimental premium fuels blended to the same Research O.N. 20% of the original data were then used to simulate a reduced programme designed and conducted in accordance with statistical techniques. A good agreement was found between the results of the original and the reduced programme. This shows that a statistically-planned programme, although curtailed in size, can adequately provide the generalizations regarding the effect of blend composition on road anti-knock performance which are required by a refinery to establish an optimum gasoline-blending policy.

It is concluded that, regardless of the programme scope, the application of statistical, money-saving techniques offers possibilities which should not be overlooked by refiners executing road-test studies. (Authors' abstract.)

1840. Spontaneous ignition temperature of hydrocarbons. D. E. Swarts and M. Orchin. *Industr. Engng Chem.*, 1957, **49**, 432–6.—It is shown that the S.I.T. of hydrocarbons may be related to their vapour phase oxidn in a flowing system, and that both processes probably occur through the same mechanisms. 8 hydrocarbons were investigated and the effects of surface : vol ratio and hydrocarbon : oxygen ratio at the S.I.T. studied. The surface : vol ratio was found to have a considerable effect and probably accounts for discrepancies in earlier work; the relation between the surface: vol ratio, the S.I.T., and the effect of pressure is illustrated by a 3-D diagram. The data indicate that the order of decreasing resistance to both spontaneous ignition and vapour phase oxide is aromatic > branched > cyclic > straight-chain olefin > straight-chain paraffin, *i.e.* in general the ease of ignition increases with the length of uninterrupted methylene chain. D. B. S.

1841. High-speed [diesel] operation on low grade fuel. Anon. *Gas Oil Pwr*, 1957, **52**, 147–8, 152.—Report of a 2300-hr test with low grade diesel fuel, which was compounded by mixing marine diesel fuel with residual oil. Since the mixture was unstable, a special circulating pump was installed in the fuel tank. A fuel additive was used to prevent clustering of sludge particles. The fuel consumption was 162–6 g/b.h.p.hr.

The greatest difficulty was experienced with exhaust valves, which became coated with V cpds and would not seat properly. By fitting another turbocharger the air supply was increased, the valve temp reduced, and corrosion was also reduced. H. C. E.

1842. Diesel traction and British Railways. J. M. Jarvis. *Inst. Petrol. Rev.*, June 1957, **11** (126), 150.—Reasons for change in motive power on British Railways from coal to diesel fuel are given, and include coal supply difficulties, manpower position, cleanliness, performance and reliability, and the economic factor. The historical background is discussed, and the application of diesel power and transmission are also dealt with. G. A. C.

GAS OIL AND FUEL OIL

1843. The role of fuel oils in Europe. P. H. Frankel. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 43–61.—The demand and supply curves for energy are examined for the years to 1968. They show that on certain assumptions there is a widening gap between available coal and hydro-electric power and the demand for energy. Unless new sources of energy, such as atomic energy, can play a significant role within this period, only fuel oils can fill the gap. Prices of coal and residual fuel oil in several countries are compared, and it is established that current fuel oil prices make it possible for consumers to expand their use of fuel oils to a considerable extent. As the Middle East appears to have sufficient crude oil reserves to cope with the increased supply which the larger-scale use of fuel oils would involve, the problem is one of refinery economics. American and European present-day yield patterns are compared with those which may be necessitated by the increased demand for fuel oil. These future yield patterns will depend on the development of motor spirit (gasoline) demand, for which 2 estimates are quoted. Some repercussions on refinery economics and crude oil prices are examined. (Author's abstract.)

1844. Improving fuel oils through addition agents. W. de B. Bertolette and J. D. Rogers. *Petrol. Engr*, 1956, **28** (12), C41–6.—The main purpose of oil additives considered here is to improve storage and thermal stability. For furnace oils, clogging up of the burner nozzle and filter by sediment can be minimized by adding metal petroleum sulphonates, polar polymers, and alkyl amines, while gels can be eliminated by metal de-activators of the salicylidene propanediamine type. Difficulties with diesel fuels can be reduced by using cat cracked stock of lower cetane number or using stabilizer-dispersant-type additives. In jet fuels thermal instability is the main problem, gums and residues being formed, but polymeric dispersant additives have again proved effective. In conclusion, it is pointed out that new problems, namely, formation of emulsions when the fuel is agitated with water, must not be created in too liberal application of additives. E. A. G. H.

LUBRICANTS

1845. Lubricant specifications. 3. E. G. Ellis. *Sci. Lubric.*, 1956, **8** (8), 23–8.—British Railways specifications for oils for road motor vehicles, railway rolling stock, and locomotives are set out and discussed in detail, and the essential points in the formulation of specifications for lub greases enumerated. J. G. H.

1846. Lubricant specifications. 4. Crankcase oils. E. G. Ellis. *Sci. Lubric.*, 1956, **8** (9), 19–25.—The background of crankcase oil specifications through BS, Caterpillar, and CRC tests is briefly sketched and current U.S. Army, British Standard, Ministry of Defence, and London Transport specifications are set out and discussed in some detail. J. G. H.

1847. New methods of evaluation of lubricating oils; corrosion of lead bronzes; the laboratory evaluation of the effectiveness of multifunctional additives. Z. Stepek. *Prace Instytutu Naftowego*, 1955, Series B, No. 39, 1–20.—Whereas before world war II the evaluation of additives concerned itself exclusively with the oxidn of oils, nowadays the multifunctional additives require much more complex and varied testing. The paper concerns itself with finding the best set of tests to determine the various qualities of oils with additives and also with finding the best additive for the highest grade of Polish lubricants, Lux oils. These, it has been found, vary from time to time, depending on supplies of crude. M. S.

1848. Important developments of lithium-base greases. Anon. *Gas Oil Pwr*, 1957, **52**, 120.—The use of lithium 12-hydroxy stearate in Shell Alvania greases confers a high degree of mechanical stability. These greases also contain a water-soluble corrosion inhibitor which protects the bearings from the effect of water. Another feature of the grease is its increased resistance to dynamic oxidn; at 135° C the life of the grease is extended by a factor of 3–4. In a run under test conditions the factor was as high as 24.

It is stated that under normal conditions where reasonable power is available Alvania greases 2 and 3 can be used in roller bearings at temp as low as −20° C. H. C. E.

BITUMEN, ASPHALT, AND TAR

1849. Use of van Krevelen's densimetric method for investigating the structure of bitumens and asphalts. (In German.) J. Varga, V. Hesp, and E. Haidegger. *BrennstChemie*, 1956, **37** (21–22), 363–5.—The densimetric method—developed by van Krevelen for investigating coal structure—is applied to hard and soft asphalts derived from mineral oil and high-mol.-wt. coal dist residues and their blown products. Relative data calc with the help of sp. gr. and elementary analysis are tabulated. Results show that—in material from Nagylengyel petroleum—the No. of C atoms in aromatic combination increases with increasing mol. wt. Ring composition of the hard asphalts from mineral oil dist residues of different origin shows that hard asphalt cpds of mineral oil from Lispe (Hungary) and Lobau (Austria) exhibit a much less aromatic character than the hard asphalt of Nagylengyel mineral oils, and that, in contrast, the val of the ring condensation index, which shows the No. of C atoms at the branching positions, is higher in the former than the latter. 19 refs. R. T.

1850. State practices in bituminous concrete. W. E. Chastain. *Rds & Str.*, 1957, **100** (5), 177.—A summary is given on bituminous-concrete practice based on information from 50 highway agencies to serve as a basis to pattern the construction of the experimental flexible pavement to be tested during the A. A. S. H.O. road test. Particle size, asphalt penetration grades, density requirements, and thickness design are considered. G. A. C.

1851. Physical properties of asphalts in thin films. C. Mack. *Industr. Engng Chem.*, 1957, **49**, 422–7.—The force per unit area required to rupture thin films of asphalt contained between 2 steel plates was measured at 77° F. The asphalt was found to behave like a solid in that flow did not occur, and rupture at film thicknesses between 0·002 and 0·007 cm was sudden. Film strength was found to increase linearly with film thickness to a max and then decrease, and it was observed that there was a relation between the max film strength and the surface tension. For most asphalts used optimum film thickness increased with visc.

The bearing strength of asphalt–sand mixtures used in making pavements was also investigated, and it was found that calculated film thicknesses at optimum asphalt content were of the same magnitude as the optimum values obtained using steel plates. D. B. S.

1852. Quantitative estimation of single components in low-temperature-carbonization and coke plant tars for their evaluation and simplifying their technical processing. (In German.) A. Jäger and G. Kattwinkel. *BrennstChemie*, 1956, **37** (21–22), 375–7.—For tech processing of tars it is expedient to obtain max yields of pure components or prescribed mixtures. Thus, both lab and operational improvements are essential. Estimations additional to the conventional ones are suggested. R. T.

1853. Valuation of *m*–*p*-cresol mixtures from coke plant or low-temperature-carbonization-tar before using them for phenol–formaldehyde synthetic resin production. (In German.) A. Jäger and G. Kattwinkel. *BrennstChemie*, 1956, **37** (21–22), 371–2.—Sharper current requirements are fixed for the purity of hydrocarbons obtained from tar dist. Quant determination of the tar composition before use for producing phenol–formaldehyde synthetic resins is expedient. Conventional sales analyses are insufficient. Fractional dist is advised. R. T.

SPECIAL HYDROCARBON PRODUCTS

1854. Chemical criteria of the degradation of oil-impregnated paper in electrical equipment. J. Fabre. *Rev. Gén. Élect.*, 1957, **66**, 17–26.—In an investigation of the ageing of insulating papers the effect of various insulating oils and their oxidn products was examined. Concluded that paper deterioration due to oil and oxidn products thereof was of minor significance compared to main factors influencing paper degradation, *i.e.* temp and moisture. S content of 14 oils examined (0·14–1·5%) did not correlate with ageing tests on oil-impregnated papers. V. B.

1855. Effect of composition on the oxidation stability of electrical oils. J. L. Jezl, A. P. Stuart, and E. S. Ross. *Amer. Inst. Elect. Eng.*, 1957, Paper No. CP. 57–84, 14 pp.—Test procedures for elect oils, and their significance, are briefly described and methods of determining oil composition outlined. Results are given for 6 typical trans oils: saturates 73·2–76·3%, mono-nuclear aromatics 19·0–21·2, di-nuclear 2·8–6·2, tri-nuclear 0·1–0·8, S 0·06–0·10, oxygen 0·05–0·24. Mode of oxidn of these various groups and their inhibitor effect and response are discussed. Tri- and poly-nuclear aromatics have marked inhibitory effect, although such cpds are largely removed by most refining techniques. Nitrogen cpds are highly undesirable, but are easily removed so that only 0·001% N is present in a well-refined oil. Most S cpds are non-corrosive and beneficial. U.v. (2200–3400 A) spectra of trans oil and its aromatic components is shown. Curves are given relating oxidn stability to extent of refining for uninhibited and inhibited oils. Optimum trans oil composition for uninhibited and (inhibited) oils is, %, saturates 70–80 (70–80), mono-nuclear aromatics 12–18 (17–22), di-nuclear 5–7 (3–5), tri-nuclear 0·5–1·0 (0·2–0·5), non-hydrocarbons, *i.e.* S and O cpds, 1–2 (0·5–1·5). V. B.

1856. Reasons for high dielectric losses in new transformer oils. R. A. Lipshtein and E. N. Shtern. *Khim. i Tekh. Topliva*, 1956, (7), 64–8.—Investigation of fresh oils having p.f. (20° C) above the acceptable limit of 0·3% indicated that such high values were due to traces of metal soaps, as little as 7 p.p.m. of oil-soluble Ca (derived from use of slaked lime

as neutralizing agent for acid oil) can have marked effect. Addition of as much as ½% of naphthenic acids to oil does not markedly affect p.f. Use of NaOH neutralization followed by careful water-washing yielded oils of adequately low p.f. (*cf.* Abs. **375**, 1957). V. B.

1857. Testing of alkylphenol anti-oxidant additive in transformers. K. I. Ivanov *et al.* *Khim. i Tekh. Topliva*, 1956, (9), 51–6.—Tests on new, regenerated (silica gel), and used trans oils with and without 0·2% 2,6-*ditert*-butyl-4-methylphenol by official U.S.S.R. method (GOST 981–52) showed satisfactory effect of inhibitor, including inhibition of formation of water-sol acids in initial stages of oxidn. No inhibitor separation was noted down to −48° C and no adverse effect on trans constructional materials or on elect properties (breakdown, p.f.) of oil. Field trials in 4 trans (1 KVA) using 35 kg oil in each and with operating temp increased to 90° C (top oil layer) for 5 months were carried out using mixture (3/1) regenerated/fresh oil, 2 trans with 0·2% inhibitor, 2 trans without confirmed lab findings, *e.g.* acid val 0·26–0·48 uninhibited, 0·09 inhibited. V. B.

1858. Influence of moisture on the electric breakdown of oils and of transformer insulants. Y. Enault and R. Traiteur. *Rev. Gén. Élect.*, 1957, **66**, 79–84.—Paper immersed in insulating oil absorbs therefrom any moisture present (with increasing mechanical weakening and deterioration of electric properties) until equilibrium is established. Tests (2 months) with new dry oil, used oil, and used oil containing added free water show, in first case fall in electric strength of oil with little change of that for paper, and in other cases rise in electric strength of oil with fall in that of paper, due to moisture absorption by the latter. These results stress necessity for max desiccation of new oil, which should have electric strength appreciably above present accepted minimum, and for nitrogen-sealing of transformers. V. B.

1859. Hydrocarbon propellants for aerosols. L. D. Goodhue and H. Franz. *Soap, N.Y.*, May 1957, **33** (5), 103.—Methods of use and properties of hydrocarbon propellants are discussed. Tables show physical constants of the paraffin hydrocarbons concerned, and vapour pressure, density, surface tension, solubility of water in hydrocarbons and vice versa, and limits of inflammability characteristics are given graphically. G. A. C.

DERIVED CHEMICAL PRODUCTS

1860. New developments in industrial detergents. J. Morrisroe. *Soap, N.Y.*, May 1957, **33** (5), 47.—Tables show relation of total detergents used to industrialization, market status of synthetic and other surface-active agents, and quantity and value of cleaning preparations by all U.S. producers for periods 1954 and 1947. G. A. C.

1861. American Chemical Society. II. Anon. *Petrol. Times*, 7.6.57, **61** (1561), 494.—Further abstracts of papers given at Miami, Florida, April 1957, include synthesis of cyclic and alkyl*cyclo*alkyl sulphides, applications of higher oxo alcohols, studies on cat, and cresylic acid formation in petroleum cracking. G. A. C.

COAL, SHALE, AND PEAT

1862. Aromaticity and the colour of coal. R. A. Friedel. *Nature, Lond.*, 1957, **179**, 1237.—The hypothesis that coals consist mainly of polynuclear condensed aromatic structures is discussed. Spectral measurements in the u.v. region indicate that bituminous coals contain only small concn of such aromatics.

The colour of coal may be due to structures with unpaired electron spins (free radicals), and experiments are described which show that some properties of coal are consistent with the presence of free radicals. Another source of colour may be due to the presence of charge transfer complexes, but the magnetic, conductivity, and optical properties of coal differ from those of such complexes. H. C. E.

MISCELLANEOUS PRODUCTS

1863. Sulphur from Lacq gas. R. Guillo. *Chim. et Industr.*, 1957, **77**, 1032–7.—Gas contains 15% H_2S; feed to Claus plant is stripper gas from diethanolamine desulphurizer (50% H_2S, 37½% CO_2, 4½% H_2O, 1% hydrocarbons). Cat is activated bauxite; description of plant, and flow sheet, are given. Present capacity 60,000 tons S/year, extensions under construction will yield 300,000 tons/year by 1959, with foreseeable expansion to 1·2 million tons by 1962, of which 67% will be exportable. V. B.

1864. Swelling of nitrile rubbers by *iso*octane–toluene blends. R. E. Morris and P. T. Wagner. *Industr. Engng Chem.*, 1957, **49**, 445–8.—The effect of the acrylonitrile content of vulcanized gum nitrile rubbers on the absorption of toluene from toluene–*iso*octane blends was investigated with the toluene radioactively tagged. The results showed that the rubber preferentially absorbs toluene from the blends and that this tendency is lessened as acrylonitrile content is decreased. In addition, the greater the amount of toluene in the blend, the greater is the total amount of solvent absorbed. Explanations for the behaviour are suggested. D. B. S.

1865. The boon of man-made rubber. Anon. *Petrol. Press Serv.*, 1957, **24** (5), 173–5.—Since 1950 world rubber consumption has increased by approx 750,000 tons or *ca* ⅓. It may surpass 4 million tons by the early 1960s. There is no prospect of a significant rise in world output of natural rubber until 1960, when recent replanting should begin to show results. Thus, an additional million tons of synthetic production will be needed to fill the gap. By the end of this year American capacity alone will exceed the current output by over 500,000 tons. This expansion + Canadian and European projects will cope with future rises in demand. U.S.A. and Canada have met the rise in demand for synthetic rubber —due to 7 years' stagnation of natural rubber output—at *ca* 1·8 million tons p.a. A 5-fold expansion of rubber-making facilities is under way in W. Germany, and production on a substantial scale is forecast for Britain, France, and Italy. Production at Ravenna in Italy will be based on natural gas for making butadiene via acetylene. The British and French installations, like the new German plant, are designed for using petroleum feedstocks, in line with current U.S.A. and Canadian practice. The European-made synthetic will compete favourably with imported American GR-S in price. R. T.

1866. Mixing characteristics and use of an improved oil-extended rubber. E. E. Gale, I. W. E. Harris, and S. C. Kilbank. *Trans. Instn Rubb. Ind.*, 1957, **33** (2), 33–57.—Difficulties associated with the use of oil-extended rubbers are reviewed. Unsatisfactory behaviour in short Banbury cycles is rendered more acute by using higher Banbury rotor speeds with shorter mixing cycles The extra mixing time—even using chem peptizing agents—nullified the time saved by higher speeds. Attempts to standardize mixing cycles for all rubber stocks showed that mixing behaviour of oil-extended types was objectionable—abnormally high die swell of the stock leaving the extruder—only in the sp case of relatively short Banbury cycles. In other processing characteristics they were generally comparable to unextended polymers. On the basis of this information steps were taken—with

development of a lab test for differentiating between polymers with different mixing characteristics—to develop an oil-enriched polymer with improved Banbury discharge characteristics. This has been achieved by modifying Polysar Krynol, producing Polysar Krynol 651 and its non-staining counterpart Polysar Krynol 652. A simple dispersibility test which will predict the mixing behaviour of a polymer in factory operations is described, and some effects of mol structure on mixing characteristics are discussed. In many applications, *e.g.* passenger tyre treads and camelback, the oil-extended types have replaced cold rubber with marked economy. More important applications are outlined with typical recipes and test data. Some comparisons with cold rubber cpds are given to illustrate potentialities of oil-extended types as general purpose polymers. Preliminary tyre test results are included. 11 refs. R. T.

CORROSION

1867. Organization of a corrosion engineering programme. G. Derickson. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 212–14.—This paper describes the manner in which an integrated company has organized its refinery corrosion engineering with other branches of the company to unify and co-ordinate work on corrosion problems. It discusses the qualifications and selection of the refinery corrosion engineer and the equipment with which he works.

(Author's abstract.)

1868. How 31 companies are fighting corrosion in cat reforming. E. B. Backensto. *Oil Gas J.*, 20.5.57, **55** (20), 180.—An API Committee survey of 31 company experiences in excessive metal loss, scaling of furnace tubes, plugging of cat beds, and fouling of heaters and exchangers. Most widely-used methods of combating corrosion included selection of proper alloys, feedstock desulphurization, H_2S removal in recycle gas, and aluminizing. G. A. C.

1869. Low pH receiver waters cut corrosion. J. A. Biehl and E. A. Schnake. *Oil Gas J.*, 20.5.57, **55** (20), 157.—27 months operation at Ohio Oil Co's Robinson, Illinois, refinery with a crude oil unit at high and pH of overhead waters showed that the pH of the receiver waters should be reduced to *ca* 4·3 with inhibitor injections varying from 10 to 15 p.p.m. in order to eliminate after effects and protect equipment. The lower pH minimizes ammonium-salt dissociation, and clean equipment greatly reduces maintenance costs and permits longer runs at increased charge rates. G. A. C.

1870. How corrosion inhibitors work. P. D. Muir. *Petrol. Engr*, 1956, **28** (12), B27–9.—The several theories regarding the manner in which inhibitors function are discussed. In many inhibitors, a general adsorption, cathodic and anodic adsorption, chemisorption and physical adsorption and preferential oil wetting probably all combine to provide corrosion protection. These mechanisms can reinforce each other, and in most cases it is believed that more than one mechanism is involved. E. A. G. H.

1871. Cathodic corrosion control of pipelines. R. A. Lowe. *Petrol. Times*, 10.5.57, **61** (1559), 411.—Techniques employed in cathodic protection of buried pipelines are reviewed, and include discussion of life of protection equipment, power impressed systems, and design of circuits. G. A. C.

1872. The search for greater stress resistance in enamels. L. F. Bramble. *Pipe Line News*, 1957, **29** (5), 50–4.—The requirements of a good pipe coating are discussed. Improvements made to asphalt enamels in order to make them more stress-resistant and easy to apply are briefly mentioned.

D. B. S.

ENGINES AND AUTOMOTIVE EQUIPMENT

1873. Feeding problems for future engines. A. E. Cleveland and R. J. Potter. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 179–89.—The modern automobile has developed in a favourable environment of compatible roads and fuels, including high octane fuel for high compression engines. The co-operation and co-ordinated effort of the auto and petroleum industries that was applied to meet to-day's octane requirements should be extended to include the problem of fuel volatility. Engine-head dissipation is becoming a serious problem with increases in h.p., engine size, and number of accessories, together with diminishing underhood space. High engine-compartment temp coupled with high-volatility fuels may cause vapour lock, reduced performance, high fuel consumption, hard starting, poor idling, and carburettor icing. The detrimental effects of high volatility may be reduced by various mechanical devices, but future engines may require more effective measures. Fuel injection systems will not solve vapour-handling problems; they are ever more vapour-sensitive than the carburettor. Consideration of all present fuel characteristics indicates an urgent need for a standardized rating system and nomenclature for fuel volatility to assure compatibility of future engines and fuels.

(Authors' abstract.)

1874. The combustion chamber deposit problem in high compression ratio engines. M. W. Corzilius, D. R. Diggs, and R. A. Hoffman. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 162–78.—Because of the steadily increasing C.R. of passenger-car engines, which results in the demand for higher-quality fuels, refiners are faced with increased costs in the production of fuels necessary to satisfy these engines. In order to investigate the fuel requirements of future engines, and some effects of fuel and oil composition on these requirements, a test programme involving engines having C.R. as high as 11 : 1 has been conducted both in the lab and on the road.

It was found that an engine with 11 : 1 C.R. could be operated under normal conditions, free of combustion noise, on 100 O.N. fuel. Power-package design, fuel, and lubricant all had a significant effect; careful choice of all 3 must be made to keep octane requirements at a minimum.

The 90% distilled point apparently was not, *per se*, a criterion for measuring deposit harm of fuels. Multigrade lubricants were generally quite good in reducing deposit harm, but a synthetic lubricant was even better, indicating that improvements in lub oils are still possible. Also, the inclusion of high-visc petroleum fractions in multigraded lubricants did not necessarily affect deposit harm adversely.

Surface ignition was of negligible proportions at 9 : 1 C.R., even under the most adverse conditions. At 11 : 1 C.R., surface ignition was much more prevalent. Again, however, it was demonstrated that engine design, fuel, and lubricant could be selected so as to reduce the incidence and severity of surface ignition to acceptable levels. (Authors' abstract.)

1875. R.A.C. Report on exhaust smoke. Anon. *Gas Oil Pwr*, 1957, **52**, 106.—Following observation on 12 hills of gradients 1 in 25 to 1 in 10, a committee comprising various users of diesel-engined vehicles and other interested bodies

met to consider from the aspect of road safety the problem of exhaust smoke emission. It was decided that black smoke emission is most often caused either by incomplete atomization of injected fuel or by an incorrect air–fuel ratio due either to faulty maintenance or to improper use of the excess fuel device.

The Committee recommends that: (1) regular, adequate, and competent maintenance of the combustion system is essential; (2) abuse of components should be obviated by educating the drivers of diesel-engined vehicles in the dangers of such practices as well as their effect on fuel wastage and engine life. Legal measures are already adequate for abating the nuisance. H. C. E.

1876. The largest marine diesel engine. Anon. *Mot. Ship*, June 1957, **38** (445), 102.—A brief description is given of the 15,000-b.h.p. Japanese unit of the Burmeister Wain turbo-charged 2-stroke type. This engine is to be installed in the 33,500-ton tanker *Yugo Maru No. 5*. 2 photographs. D. K.

SAFETY PRECAUTIONS

1877. Toxicity of fumes from a diesel engine under four different running conditions. R. E. Pattle *et al. Brit. J. industr. Med.*, 1957, **14**, 47–53.—Single cyl air-cooled engine operating on ½% S, 47 cetane, fuel. Running: (1) light; (2) under load (5½ b.h.p.); (3) under load with worn injector; (4) light with restricted air intake. Fume composition; CO 0·04–0·17%, NO_2 12–51 p.p.m., N oxides (as NO_2) 44–209 p.p.m., aldehydes (as HCHO) 6–154 p.p.m. Tests with guinea pigs, rabbits, mice. Animals not dying from exposure were subsequently killed for examination. Post-mortem findings are discussed. At (1) acrid fumes, main toxicity organic irritants and NO_2; (2) yielded more lethal fumes, NO_2 main toxic agent; (3) toxicity and acridity decreased; (4) gave very acrid lethal fumes, toxicity being mainly due to CO. Under all the conditions little black smoke was present in the exhaust. Tests for irritancy and lachrymancy also made, and it is emphasized that these effects can vary with little or no detectable change in chem comp of fumes. V. B.

1878. Safeguards against the explosion hazard in industry. F. H. Mann. *Elect. Times*, 1957, **131**, 273–5, 391–5, 473–8, 615–20, 851–5, 993–6.—(1) Review of problems, and available solutions, accompanying risk from elect equipment in potentially explosive atm; (2) discussion of flameproof equipment and of methods for determining safe gap; (3) flameproof construction of elect plant and test procedures for flameproof installations; (4) intrinsic safety, definition, gas classification (2 classes, hydrogen and pentane, distinct from flameproof grouping), test and certification of intrinsically safe circuits and apparatus, self-contained certified apparatus; (5) pressurized systems; air-flow and static systems (with diagrams), application to "excluded" gases, air curtain, pressurized rooms, factors governing choice and type of pressurized system; (6) inflammable dusts and their characteristics. Continental "augmented safety" practice. V. B.

MISCELLANEOUS

1879. The independent consultant and the user of petroleum products. A. L. Temby and H. A. Ruffell. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 15–20.—The role of independent consultant to the marketers and users of petroleum products has been taken by the Petroleum Section of the Australian Defence Standards Laboratories in the post-war years. The paper shows the valuable part that can be played in a young country with a rapidly expanding secondary industry by a lab functioning as a consultant to the Armed Services, Government-operated munitions industries, and private industry. (Authors' abstract.)

1880. Interdependence as the foundation for world oil operations. W. J. Levy. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 31–41.—There are 4 principal types of participants in world oil operations: the producing and exporting countries, the international oil companies, the consuming countries dependent on oil imports, and, on a slightly different level, the parent countries of the oil companies. These participants stand in a variety of relationships to one another: a functional, or "vertical," relation between the members of any one chain of operations, from production through refining and transportation to distribution, and a competitive relation between the participants in any one chain and those engaged in other chains of operations. An effective functioning of the world oil economy is possible only through the endeavours and the continuous contributions of all the participants. In order to assure that these contributions will be forthcoming, they must, of course, be matched by essential benefits to each. The effective adjustment and reconciliation of the varying interests of the different participants require a delicate balancing of many essential considerations, including those affecting nations at different stages of economic development and with diverse political, social, and legal systems, and those involving the relationship between sovereign powers and private commercial interests. The 3 most fundamental sets of conditions relevant in this connexion are: (1) the recognition of interdependence; (2) the force of competition; and (3) the threat of countervailing power. The recognition of interdependence implies the realization that the contribution of each of the participants is vital and that each one of them must be able to obtain certain benefits if his co-operation is to be forthcoming. Competition and free choice in the market place are essential to the equitable balancing and adjustment of the various divergent interests involved. Finally, as oil operations involve the security and vital interest of nations, any attempt by any one party to exert unwarranted pressures beyond the point of basic equity would bring into play countervailing powers. Accordingly, each of the participants must accept freely as his guiding and limiting consideration the pursuit of his enlightened self-interest based on the recognition of mutual interdependence and founded on the respect for his own obligations and on the basic rights of others. The concept of enlightened self-interest has found an ever wider acceptance during the last decade or so. Against this background there has been an unprecedented performance by all participants. In fact, they have been able to make a unique contribution to the prosperity and security of all members of the peace-loving world by assuring a continuously expanding production, furnishing large revenues to producing countries, and providing uninterrupted access to supplies and markets through all contingencies. (Author's abstract.)

1881. 110 Research Octane by 1960? S. P. Blumberg. *Oil Gas J.*, 20.5.57, **55** (20), 137.—From extrapolations of current trends in increasing engine C.R. it is indicated that high-performance cars of 1960 will require premium motor fuel of approx 110 research O.N. This will require additional refinery investment of $18,000,000 and an increase in total investment of 40%. An existing 50,000-b.d. refinery is studied and a

4-step programme given. Tables show gasoline-quality data, material balance economics and investments, and effect of 3-grade system of gasoline marketing. A simplified flow diagram of a future refinery showing 4 steps to make the highest practicable octane gasoline pool is also given. G. A. C.

1882. Effective statistical analysis for management. R. J. Gonzalez. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 1–6.—Effective statistical analyses can be valuable tools for management. Properly organized and analysed, statistics can provide the basis for better decisions on many complex problems. Statistical analysis should seek to establish the whole truth. The fundamental starting point is an understanding of the data and a consideration of all pertinent facts bearing on the problem. Analyses prepared for management should be designed to present the essential points quickly. A brief introduction should summarize the problem and the conclusions. The report should select and arrange data in a manner that conveys meaning quickly and clearly and should avoid massive tabulations that discourage the reader. Any oral presentation of statistical data should rely heavily on the use of charts to facilitate comprehension. The systematic application of statistical analysis to the study of business problems is a relatively new development. A wide scope of opportunity remains for extending and improving such work. How much can be accomplished will depend on the imagination and skill of the specialists in this field. If their work is well done, analysts can make a creative contribution to the management of business and to the better functioning of our economic system. (Author's abstract.)

1883. Education for management in the petroleum industry. W. B. Maloney. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 7–14.—The art of management is susceptible to guidance. This concept is being widely accepted all over the world, especially in the petroleum industry. The prime essential of a manager's job is to get things done through people. The petroleum industry is especially alert to this need because of the size of investment per employee as compared with other major industries. Therefore, the understanding of human relations looms as the largest educational need for future management. Over 30 colleges and universities in the U.S.A. are featuring this aspect in their advanced management course. This type of educational effort is spreading all over the world, and has the common characteristic of giving a lot of attention to the human relations factor of management's job. Management development consists of 2 essential parts—selection and training. Selection methods are being studied and will be improved. Training features giving those selected opportunities for self-education by doing. Future managers will have to understand and accept these basic principles: that only individuals can give the kind of loyalty that makes an organization great; that individuals will be more productive and enthusiastic if they perceive a sense of participation; that people work in groups and are often represented by group leaders, with whom the manager must learn to deal successfully. The challenge of providing competent managers for a dynamic future for the petroleum industry can be met by education if that education features understanding of people. (Author's abstract.)

1884. Influence of engineering progress on the oil industry. Anon. *Petrol. Times*, 7.6.57, **61** (1561), 484.—A review is given of papers presented at the IP Summer Meeting, Folkestone 1957, and concerns electrical, marine, civil, mechanical, and chemical engineering, and metallurgy. G. A. C.

1885. Economic considerations. R. W. Heath. *Proc. nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 47–9.—The term speculation is applied to the factors which have to be considered in deciding on the economics, design, and construction of a new gasoline plant. Numerous hazards must be met, in which speculation may be a controlling factor. Good engineering practice and a practical economic study will reduce the hazards to a minimum. R. T.

1886. Process management skill for your business. J. R. Suman. *Proc. Nat. Gas Ass. Amer., 35th ann. Conv.*, 1956, 78–82.—The importance of developing executive talent on both a medium- and long-range basis is emphasized. Functions and objectives of an executive are discussed. The good executive must have tech, human, and conceptual skill. Shortage of engineers is serious. Over 5000 firms are now bidding for this year's supply of B.A. and M.A. graduates. Companies are encouraging better teaching of science in the high schools. The *Petroleum Week* for 16 March publishes Shell's efforts. A fundamental principle is to know what the management structure of a company must be. Candidates must be selected with the required qualifications. A simple method of appraising the candidates selected should be established. The training necessary to complete the candidate's experience should be provided. R. T.

1887. Service of the I.S.A. to the petroleum industry. R. T. Sheer. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 117–19.—The Instrument Society of America, with its goal of advancing the sciences of instrumentation and automatic control, offers many advantages to the petroleum industry. The Society is technical rather than professional. Its membership covers a complete range of interested persons, from executives to engineers, technicians, and sales personnel. Its publications are the authentic source for keeping informed on the latest developments in the field.

The horizontal nature of the Society makes possible the cross-fertilization of ideas from one industry to another. The I.S.A. has had its biggest growth and acceptance in the process industries, primarily in chemical processing and petroleum. Increased use of automatic controls to perform an increasing number of tasks is forecast for the immediate future. It is predicted that automation will make as much progress in the next 10 years as it has in the past 20. Other I.S.A. services to members are the annual conferences, meetings, and shows. An educational commission has been formed to study the future needs of education and training for the field of automatic control and automation.

(Author's abstract.)

1888. Toxicity of α,β-unsaturated carbonyl compounds to micro-organisms. V. T. Stack. *Industr. Engng Chem.*, 1957, **49**, 913–17.—Biochemical oxidn of industrial waste is affected by the toxicity of components to the micro-organisms used. α,β-unsaturated carbonyl cpds were found to be strongly toxic to micro-organisms in the following order—aldehyde, ketone, ester, and acid. D. B. S.

1889. Petroleum for our future progress. R. J. Gonzalez. *J. Petrol. Tech.*, 1957, **9** (3), 14–21.—Oil and gas supply $\frac{3}{4}$ of the energy currently consumed in the U.S.A. From a study of various factors it appears that domestic crude output could be sustained at 2,000,000 b.d. above the Oct 1956 level for 3 years or more, even with reduced drilling. Present or increased drilling rates should continue the rise in availability of oil. Estimates of U.S. reserves give figures of $150–200 \times 10^9$ brl of oil, but these are based on conservative views on recoveries and other factors. The Dept of the Interior has suggested 300×10^9 brl as a reasonable reserve figure, and this may be surpassed.

It is desirable that the proportion of imported crude should not be too high. A moderate amount stimulates domestic activity; a large amount would harm progress and security. Proper taxation provisions are necessary. This is particularly the case with respect to depletion allowances. The existing depletion rate comes close to measuring the capital value of oil in the ground. Sales indicate that the current price of

developed oil reserves is *ca* \$1·25/brl. Drilling and equipment costs may be \$0·4–0·5/brl of reserves, giving the value of oil in the ground for the purposes of depletion as *ca* \$0·75–0·85/brl. The max percentage depletion deductible on the present average price of crude oil of \$2·8/brl is \$0·77/brl. Effective depletion over the life of a producing property is less than 27·5% of gross income because of the limitation to 50% of net income before depletion. G. D. H.

1890. Growth of a technical computing activity. C. M. Jones and T. H. Green, Jr. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 229–31.—A brief analysis of the management aspect and evolution involved in the growth of a technical computing activity is briefly presented. The growth of understanding in the use of automatic computation as a contribution to technical programmes is outlined, and specific examples for each phase of development are listed. The developed need for automatic computers, the acquisition and training of adequate personnel, and the actual procurement of suitable computation equipment are listed as the 3 most important steps in the development of any technical computing programme, with prime emphasis being placed upon the development of the need and the proper organizational position and staffing of the equipment for its most efficient use.

(Authors' abstract.)

1891. Review of the Smoke and Fumes Committee research programme. L. C. Kemp, Jr. *Proc. Amer. Petrol. Inst.*, 1956, **36** (III), 284–7.—The Smoke and Fumes Committee's programme of fundamental research on air pollution, as related to the transportation, refining, and use of petroleum and its products, is nearing the end of its third full year of operation. During this period almost \$750,000 has been spent on 10 research projects. Of these projects, 2 were completed prior to 1956, and 4 are being completed during 1956. 4 new projects are being started. Close liaison is maintained with other groups working on the problem, and every effort is made to avoid duplication of the work of others and to obtain useful information from the Smoke and Fumes Committee's research projects. The projects have already made substantial contributions through the development of improved analytical devices and methods, through provision of more reliable information on the sources of pollutants, and through the development of new and important information on the reactions of pollutants in the atmosphere. Much valuable information should come from the work to be done in the future. (Author's abstract.)

1892. Gas-gathering-system design is a natural for the electronic computer. A. E. Hass and J. B. Benear. *Oil Gas J.*, 13.5.57, **55** (19), 132.—Use of the computer by Cities Service Oil Co in designing the gas gathering system for Roberts Ranch gasoline plant in Texas showed advantages in high speed, greater accuracy, made it relatively simple to design a number of systems with different initial and terminal pressure, and allowed the economics of each to be compared.

G. A. C.

1893. Bank financing of secondary recovery projects. C. L. Brown. *J. Petrol. Tech.*, 1957, **9** (3), 22–5.—Forecasts indicate the U.S. domestic oil needs as 9,155,000 b.d. in 1957 and 13,375,000 b.d. in 1966, while the producing rates are estimated as 7,600,000 b.d. and 9,250,000 b.d. respectively, for these 2 years. Secondary recovery has an important role in meeting future oil requirements, and the average independent oil operator will need financing, either for the acquisition of the property or for its development.

To qualify for a bank loan a secondary recovery project must be a safe commercial investment. Hence the bank considers the managerial competence of the operator, the engineering information and programme, and an economic analysis of the project and proposed financing. A pilot flood should be at a sufficiently advanced stage to be able to compare predictions and performance before a bank can make a loan. To qualify as a sound investment the loan, together with the interest charge, should have an amortization period commensurate with the nature of the proposed operation. For a water flood this should not exceed 5 years. At least $\frac{1}{2}$ of the estimated reserves should remain after the indicated pay-out. For progressive development a series of loans may be needed.

The Olympic field Senora sand waterflood is used as an example. For a typical lease peak waterflood oil rate was over twice the peak primary rate, and secondary recovery is estimated to give more than 3 times primary recovery. Water-injection costs ranged about 8–22c/brl.

An example of cash projection, pay-out, and value of a small waterflood is set out. G. D. H.

1894. Plant size a factor in determining whether to contract maintenance. L. Turner. *Oil Gas J.*, 24.6.57, **55** (25), 126.—A survey of a number of refineries in the U.S.A. and Canada shows that 45% of these use some contract maintenance, and most frequently for unit turnabout than for routine work. Results of the survey are given in 3 tables. G. A. C.

1895. Refining Division of the American Petroleum Institute. Anon. *Petrol. Times*, 5.7.57, **61** (1563), 587.—Abstracts are given of papers presented at the 22nd mid-year meeting, Philadelphia, May 1957, and subjects include corrosion, analytic research, fuels, electrical equipment, instrumentation, isomerization and reforming, training, and pollution.

G. A. C.

1896. International Catalysis Congress, Philadelphia, 10–14 Sept 1956. J. C. Balaceanu and H. van Looy. *Rev. Inst. franç. Pétrole*, 1957, **12**, 358–66.—Brief survey of main trends and list of papers. V. B.

1897. Industrial developments of radiochemistry. J. C. Balaceanu. *Rev. Inst. franç. Pétrole*, 1957, **12**, 354–7.—Brief survey of U.S. progress and of fields outlined at Atomic Industrial Forum (Chicago, 25–27 Sept 1956); various radiation sources (accelerators, radioactive elements, reactors) are compared. V. B.

1898. Right-of-way problems are everybody's business. F. A. Smith. *Pipe Line Ind.*, 1957, **6** (1), 36–40.—Problems confronting pipeline engineers and land departments are discussed. Immediate contacts with all parties concerned—landowners, interested persons, and civic groups—will smooth the way for maintenance and operating personnel. R. T.

1899. Bolivia attracts the explorer. Anon. *Petrol. Press Serv.*, 1957, **24**, 222–4.—Bolivia's grave economic and financial position has followed on nationalization of foreign-owned tin mines. A stabilization plan—put into operation this year—which introduced a single, fluctuating exchange rate, freed the economy from many controls and introduced other reforms. Support has come from the International Monetary Fund and the U.S.A. A new oil law promulgated and approved by Congress in Nov 1956 has attracted foreign oil companies. Oil development has suffered from consequences of nationalization in 1937 of Jersey Standard's properties. Previously YPFB, the State oil entity, formed to take over Jersey Standard's properties, had a virtual monopoly of search, production, and marketing, but Glenn H. McCarthy was granted a concession in the Gran Chaco region in 1954. The new law divides the country into 6 areas—shown on a map—the one from which all production comes is reserved to YPFB. Terms of the new oil law vary in respect to the different zones. Annual surface taxes in respect of exploitation rights are payable in U.S. currency, and vary for each zone; they rise each year to a max then decrease. Bolivia's

crude oil production was *ca* 3·2 million brl in 1956. The Camiri field accounts for *ca* 94% of the country's total production. Present production meets all local needs—last year 2·2 million brl—and covers all possible exports. R. T.

1900. The Isthmus of Suez. Anon. *Rev. Pétrolière*, Sept 1956, (983), 21–5.—An article published by De Lesseps in the first No. of his journal *The Suez Isthmus* on 25 June 1856, is reproduced. Approval of the canal project—a benefit to E. and W. hemispheres—by a body of expert European engineers followed a critical examination. The enterprise is described as non-political, with no international rivalries and avoiding all irritation and division of large interests. Its mission will be conciliation and peaceful cementation. Tribute is paid to the old Egypt for its initiative in this work. The Convention, intended to guarantee free use of the Maritime Suez Canal, is reproduced in detail. (Constantinople 29 Oct 1888.) The President's decision promulgating Law 385 of 1956 and nationalizing the Universal Maritime Suez Canal Co, and an Egyptian committee appointed to administrate the Canal are published. The proposition adopted by the 18 Powers at the London Conference 23 Aug 1956 is reproduced. R. T.

1901. Sahara, report of the Economic Council. Anon. *Rev. Pétrolière*, Sept 1956, (983), 41–5.—A report on the tech, human, and administrative problems of the Sahara, supplied by a special commission, to the Economic Council. R. T.

1902. Thriving Australia. Anon. *Petrol. Press Serv.*, 1957, **24**, 255–8.—Statistics indicate that Australian economy is very sound. The population is rising by 2·5% p.a., energy use by 5%. *Ca* 70% of the energy comes from coal and wood. With persistent transport growth and widening use of oil in industry, petroleum products provide 25% of all energy needs. From 1945 to 1955—with an increase from 7 to 17%—oil is replacing coal in the SE. states, due to oil's inherent advantages for certain purposes. Gas production at Lurgi coal-gasification plant is 15 million ft³/day. L.P.G. is finding an increasing market. Electricity capacity—80% from coal-fired stations—is expected to be doubled in 10 years. Little scope exists for hydro-electric schemes, but the Snowy Mountain scheme will generate 3 million kW by 1975 to provide 20% of the supply for N.S.W. and Victoria. Major petroleum product consumption—57·5 million brl in 1956—is rising rapidly. Gasoline consumption rose 75% to over 27 million brl in 1956, having trebled in 10 years. Australia is the fourth most highly motorized nation. The railways—state-owned—are run on a deficit, but change-over to diesels is cutting costs sharply. Diesel fuel is gaining ground for tractors; kerosine-driven tractors are still numerous. Oil distribution is highly competitive; 93% of the 16,450 stations are one-brand. Australia still lacks a source of crude supply at home. Despite many years' search in Australia and Papua, no commercial discoveries of crude oil have yet been made, but a number of companies, with some participation by large international groups, are persisting, and several wells are drilling now in various states. R. T.

1903. Progressive New Zealand. Anon. *Petrol. Press Serv.*, 1957, **24**, 218–20.—Oil plays an increasingly important role in New Zealand's economy. Inland consumption exceeded 1 million tons in 1954, probably 1,200,000 tons in 1956. High *per capita* consumption, *ca* 200 gal, is largely due to motor vehicle increase. Gasoline consumption rose from 525,800 tons in 1951 to 675,400 tons in 1954, and to *ca* 800,000 tons in 1956, = 65% of the total petroleum consumption. *Per capita* consumption was 109·4 gal last year. Manpower shortage is severe on the state-owned railways. Operation by diesel-electric locomotives is increasing. Aviation fuel consumption has advanced rapidly in recent years to over 36,000 tons in 1956. Aviation techniques are used largely in agriculture for top dressing, etc. At the end of 1956 the estimated No. of tractors was 65,000; tractor fuel, gasoline, diesel, and power fuel sales have risen accordingly. Electricity—over 90% hydro-generated—is the most important energy source. Demand has outstripped hydro-electric capacity. In South Island capacity is ample. In North Island the margin for expansion of hydro-electric power is small, and a coal-fired station to generate 180,000 kW is under way near Waikato coalfield. The Government is building a geothermal station to generate 40,000–60,000 kW, another plant to generate 250,000 kW will cost approx £22 million. Known oil resources are very small. The only production is *ca* 1000 tons p.a. in the Monturo field on the W. coast of North Island. R. T.

1904. Scope in China. Anon. *Petrol. Press Serv.*, 1957, **24**, 253–5.—Trade between Communist China and the West will be eased as a result of the U.K. Government's decision to relax controls upon export to China of various classes of goods. The exact position is uncertain under the rapidly changing economic conditions. Petroleum supplies occupy a special position. Local oil industry will probably fail to reach the production target of 2 million tons of natural crude and synthetic oil, a retarding factor in economic progress. China must give high priority to importation of oil industry equipment and plant. Oil consumption has fluctuated between 1·2 million metric tons in 1937 and *ca* 2 million tons currently. Coal shortage—the main fuel—has led to increase of the potential market for fuel oil. Oil demand is covered currently by indigenous production and imports from Russia and Rumania. China's oil production from all sources has risen from *ca* 450,000 tons in 1945 to 1,176,000 tons in 1956; it is hoped to raise it to 5–6 million tons in 1962. Transport from E. Europe will be facilitated by completion of the new Russian pipeline to Irkutsk. Of last year's production *ca* 1·2 million tons came from the Yumen area and 500,000 tons from Manchurian shale and coal oil plants. Extensive exploration is proceeding, namely in the Karamai field, which may hold 100 million tons of crude. Planned expansion of oil production, with increases in refining and distributing facilities, will necessitate imports of products of the engineering industries. No doubt China, like other Communist countries, will wish to work under bilateral trading agreements. R. T.

1905. Japan jumps ahead. Anon. *Petrol. Press Serv.*, 1957, **24**, 207–9.—Steel and elec power shortages hold industrial expansion in check. Over 70% of total energy supplies are met by hydro-electricity and coal. Possibilities of increasing the former are limited It is hoped to increase coal output by 10 million tons to 45 million tons. Oil must cover the increase in Japan's energy requirements, and a rise in petroleum consumption appears inevitable. It has increased 2·5 times since 1952, when the pre-war level was reached. In 1957 inland consumption is expected to rise 10% to 11 million long tons. Estimated 1965 consumption will be 2·5 times the 1955 figure, or *ca* 21 million tons, and in 1975 *ca* 41 million tons. Increase in petroleum consumption is probable from road transport development. Refinery expansion is marked, present capacity is 325,000 b.d., compared with 74,000 b.d. in 1954. This has been facilitated by association of major international oil companies. Refineries are being extended. With local crude only *ca* 320,000 tons p.a., almost all Japan's petroleum needs are covered by crude and fuel oil imports. Intense search for new reserves is being made both at home and abroad. An immense problem lies ahead in finding the means to pay for oil imports amounting to 10% of her import bill. R. T.

1906. The place of oil and natural gas in the European energy economy. J. A. van den Duevel. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 121–52.—The study deals with the share one may expect oil and natural gas to represent in the total energy

consumption pattern of the O.E.E.C. Member countries. First the history of oil consumption in Europe from 1900 to 1953 is briefly recalled. A comparison of oil consumption indexes with indexes of production in manufacturing industries on the basis 1948 = 100 shows that since the end of the last war the former increases at a much higher rate than the latter. Various statistics are given in order to throw some light on the present situation of the European oil market. The consumption, total and by-product, *per capita*, varies widely from one country to another. Although it is difficult to assess the precise reasons for these variations, it may be taken for granted that measures adopted in different countries, such as diversified taxation systems, have resulted in a complete distortion of the picture, which should be governed by the free play of competition between the various forms of energy. In 1953 the gross energy requirements of the O.E.E.C. area amounted to *ca* 4500×10^{15} calories. The contributions of the various primary energy sources were as follows: gross water power 3%, natural gas 1%, crude oil 16%, and solid fuels 80%. In endeavouring to assess a general future trend of energy requirements, it is assumed that the energy consumption of a normal and expanding economy shows a long-term steady increase, on which the influence of succeeding periods of business prosperity and recession is superimposed. Subsequently, forecasts for those energy sources which show the strongest and steadiest trends of increase are dealt with. It is estimated that, under average conditions, the development of the O.E.E.C. hydro-electric power potential will be carried out at the annual cumulative rate of 6%, that natural gas will be produced in 1965 at 5 times the 1953 rate, and that the consumption of all petroleum products will increase at an annual cumulative rate of 5%. Unless it is possible to keep the price of energy within reasonable limits, W. Europe will run the danger of ultimately jeopardizing its ability to compete with other producing areas. All the well-known but sometimes highly contentious arguments of an economic, social, or strategic nature should be most carefully weighed before leading, on the part of governments, to measures of a discriminatory nature directed voluntarily or involuntarily against the increased consumption of petroleum products as such. The distortions caused in the energy consumption pattern by such measures are frequently aggravated by other governmental interventions, mostly intended at the outset to meet fiscal requirements only. In conclusion, it is believed that petroleum products will take, on the energy market of 1965, a position which will be at least equal to that outlined above, roughly covering ¼ of the total energy requirements. Any developments of overall energy demand beyond the estimates established would have to be largely met with the aid of petroleum products.

(Author's abstract.)

1907. The utilization of petroleum fuels in Europe. W. M. Holaday and R. E. Albright. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 77–98.—The trends in energy demand and energy sources for W. Europe are analysed and compared with the past and predicted trends for the U.S.A. Particular attention is given to the production and use of petroleum fuels, both on the basis of product type and on the basis of end use. In each of the 3 principal fields of use—transportation, heating, and industrial operations—the factors affecting the selection of fuels are discussed, in particular the significance of utilization efficiencies and taxation policies. The most efficient use of petroleum fuels in each of these fields is described, and a change in the pattern of European fuel use towards higher percentages of gasoline and dist fuel and a lower percentage of residual fuel is postulated.

(Authors' abstract.)

1908. Petrochemistry in French economy. J. Echard. *Bull. Ass. franç. Tech. Pétrole*, 1957, 199–215.—Discussion of French economy and balance of payments as forecast for 1961. Org chem production is forecast as 55% of all chemicals and of value of 410×10^9 fr, of this 83% is represented by 2 groups of especial petroleum chemical interest, synthetic organics and plastics. Numerous tables show production for separate classes, investment in capital equipment, balance of payments, imports, and exports. V. B.

1909. Past and future trends in energy consumption in Italy. D. Liotta, F. Bertolini, G. Verzi, and S. Gatti. *Proc. Fourth World Petrol. Congr.*, 1955, **9**, 99–120.—Italy's past and future consumption trends for energy are reviewed in the paper. The analysis of the energy balance in 1910–37 discloses some potential trends which develop in full after world war II. A very interesting relationship between industrial production and energy consumption is established after a study of Italy's pattern of energy consumption in the period 1948–54. As regards this last period the highlights of consuming sector and function trends are pointed out. In the last part of the paper an endeavour has been made to forecast on a short-term basis a pattern of Italy's energy requirements in a certain set of circumstances. Concluding notes indicate certain objectives that should be reached in order to reduce as much as possible the burden of Italy's balance of payments.

(Authors' abstract.)

1910. Petroleum law of the Republic of Turkey. Anon. *Petrol. Times*, 10.5.57, **61** (1559), 408.—A general account is given of the law regarding permits to carry out geological investigation, licences, leases, certificates, landowner rights, royalties taxation, training, and disputes. G. A. C.

BOOK REVIEWS

The Oil Engine Manual (6th Edition). D. S. D. Williams and the staff of *The Oil Engine and Gas Turbine*. London: Temple Press Ltd, 1956. Pp. liv + 330. 18*s*.

The latest edition of this manual, which was first published in 1939, covers engines for stationary and mobile industrial applications and for rail and road transport, but does not apply to marine engines.

Since the last edition in 1950 the numerous changes in engines and equipment design have necessitated extensive rewriting, but the general layout remains similar to that of the previous edition.

The manual is arranged in three sections. The first, comprising roughly two-thirds of the book, deals with the historical development and principles of operation of the oil engine; the layout of power station equipment; operational costs of industrial engines; and the utilization of exhaust and jacket water heat in stationary plants. Chapters are included dealing with combustion, fuel injection systems, pressure charging, lubrication, and maintenance; each of these covers its subject in a comprehensive manner.

Section two should be especially valuable for reference purposes. This section is subdivided into chapters dealing with engines for stationary and transportable plant duties rail and road transport work, and tractors. Oil engines are now built in Britain in such variety that there are few foreign types which have no British counterpart, and for this reason the authors decide to deal as fully as possible with British engines only. The principal details covering rated brake horse-power, speed, bore and stroke, and piston speeds of all the engines manufactured by about 60 firms are given, and are divided in sections covering various

applications, including engines suitable for use in private cars.

Section three is an appendix which includes graphs to facilitate the determination of b.h.p., b.m.e.p., and the comparison of electricity costs. Information is also given relating to fuel standards, the various standard tests used in connexion with fuel specifications, standard specifications for oil engines, and terminology used in connexion with oil engines.

The present edition of this manual, like its predecessors, gives much well-arranged information on the various types of oil engines at present available for all the types of application dealt with, and it should be very useful to those interested in the use of the modern oil engine. C. H. S.

Petroleum Cargoes—Measurement and Sampling. H. Hyams. Glasgow: Brown, Son & Ferguson Ltd, 1956. Pp. xi + 379. 50*s*.

Until the year 1931 practically no authoritative publications on the subjects of oil measurement and interrelation of units were available.

The best known publication up to that time was Davies' *Petroleum Tables*. In 1931 Peter Kerr produced *Standards for Oil Tonnage Calculations*. In 1932 The Institution of Petroleum Technologists published a volume entitled *Measurement of Oil in Bulk, Part I. Standard Weights and Measures*.

A book of Petroleum Conversion Tables was published by the Anglo-Saxon Petroleum Co. Ltd, in 1939, and a second edition in 1949.

In 1952 and 1953 the IP and the ASTM jointly published *Petroleum Measurement Tables*.

The author of the book under review has been closely associated with all the above publications over a period of 25 years, and the reader will find available valuable information on the subject of measuring oil in bulk.

Chapter I gives definitions of some 45 petroleum products; Chapter II deals with 22 laboratory tests and their significance; Chapter III—Measurement of Ships' Ullages and Cargo Volumes; Chapter IV—Sampling for Qualitative and Quantitative Purposes; Chapter V—Temperature Measurement; Chapter VI—Specific Gravity, API Gravity, and Density; Chapter VII—Calculation of Oil Quantities.

The book also contains no less than 41 tables enabling the user to cover practically the whole field of calculations necessary in oil measurement, and they are particularly suitable for tanker cargo assessment.

The publication contains very useful information in connexion with Sampling and Measurement of Petroleum Chemicals—Appendix "A." Tables 34 and 35 in this Appendix give Volume Correction Coefficients and Specific Gravity Correction Coefficients for no less than 20 petroleum chemicals in degrees Fahrenheit and Centigrade.

Appendix "B"—Sampling and Measurement of Coal Tar Products. This section supplements the information contained in Chapters III–VII, drawing attention to and describing cases where special precautions are necessary when handling coal tar products.

Tables 40 and 41 give Specific Gravity Correction Coefficients and Volume Correction Coefficients respectively. Corrections for 15 products are recorded per degree Fahrenheit and Centigrade.

There is little doubt that the book will be welcomed by a large number of persons engaged in the measurement of petroleum cargoes, especially tanker officers. W. F. J.

Chemical Engineering Practice. Vol. 3. Solid Systems. Ed, H. W. Cremer and T. Davies. London: Butterworths Scientific Publications, 1957. Pp. 534 + xviii. 95*s*.

The third volume of this series of twelve continues consideration of the solid state begun in Volume 2. The main topics covered are: size reduction, grading, mixing, storage and handling, and dust problems.

The theory of crushing and grinding based on Kick's and Rittinger's laws is well presented in the opening chapters. A short section on methods of size analysis is followed by descriptions of industrial crushers and grinding mills, and is accompanied by much useful operating and performance data.

A large section is devoted to screening, grading, and classifying operations. The various processes are considered in groups according to the basic principles involved in the separations, together with appropriate theoretical treatment. Screening based on size and shape differences is followed by settling involving buoyancy and flow resistance. Tabling and jigging are considered together, both employing hindered settling combined with flowing stream separation. A chapter is devoted to froth flotation based on selective adherence to bubbles.

Thickening and clarification are treated together as gravity sedimentation operations. Chapters on wet classification and dense medium coal washing follow, and the section is concluded by a consideration of separations based on air flow.

A short chapter on mixing precedes a useful section on storage and handling, also sampling, measuring, and gauging.

The volume is concluded with two chapters on cleaning gaseous media dealing with cyclones and electro-precipitation.

It is believed that the book will be generally useful for reference purposes on account of the combination of theoretical treatment and practical details of processes and plant, together with a good selection of recent references to the technical literature. L. G. M.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

020 British Coal Utilisation Research Association. Annual report 1956. Leatherhead, Surrey, BCURA, 1957. 74 p.

020 British Standards Institution. Annual report 1956–7. London, BSI, 1957. 272 p.

*080 Financial Post. Survey of (Canadian) oils 1957: reviewing oil and natural gas companies both active and inactive, oil and gas statistics—price ranges—maps. Vol. 15. Montreal, Maclean-Hunter, 1957. 244 p.

080 Svenska Esso Aktiebolag. Oljeåret 1956. Stockholm, Svenska Esso, 1957. 32 p.

090 American Petroleum Institute. Bulletin on performance properties of casing and tubing. 7th ed. New York, API, 1957. 11 p. (Bul 5C2.)

090 American Petroleum Institute. Recommended practice for care and use of casing, tubing, and drill pipe. 6th ed. New York, API, 1957. 13 p. (RP 5C1.)

090 AMERICAN PETROLEUM INSTITUTE. Recommended practice for measuring, sampling and testing natural gas. 4th ed. New York, API, 1957. 17 p. (RP 50A.)

090 AMERICAN PETROLEUM INSTITUTE. Recommended practice for measuring, sampling and testing gasoline and other light liquid petroleum hydrocarbons. 4th ed. New York, API, 1957. 17 p. (RP 50B.)

090 AMERICAN PETROLEUM INSTITUTE. Recommended practice for oil-mapping symbols. New York, API 1957. 2 p. (RP 35.)

090 AMERICAN PETROLEUM INSTITUTE. Recommended practice for testing oil-well cements. 6th ed. New York, API, 1957. 34 p. (RP 10B.)

090 AMERICAN PETROLEUM INSTITUTE. Recommended practice on application, care, and use of wire rope for oil-field service. 3rd ed. New York, API, 1957. 26 p. (RP 9B.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for casing, tubing, and drill pipe. 21st ed. New York, API, 1957. 47 p. (Std 5A.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for flanged steel gate and plug valves for drilling and production service. 9th ed. New York, API, 1957. 23 p. (Std 6C.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for high-test line pipe. 7th ed. New York, API, 1957. 23 p. (Std 5LX.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for line pipe. 16th ed. New York, API, 1957. 38 p.

090 AMERICAN PETROLEUM INSTITUTE. Specification for oil-field belting. 12th ed. New York, API, 1957. 51 p. (Std 1.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for oil-well cements. 4th ed. New York, API, 1957. 11 p. (Std 10A.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for rotary drilling equipment. 13th ed. New York, API, 1957. 49 p. (Std 7.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for sucker rods. 12th ed. New York, API, 1957. 28 p. (Std 11B.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for threads in valves, fittings, and flanges. (Tentative). 7th ed. New York, API, 1957. 27 p. (Std 6A.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for welded aluminium-alloy storage tanks. (Tentative). New York, API, 1957. 67 p. (Std 12G.)

090 AMERICAN PETROLEUM INSTITUTE. Specification for wire-rope. 14th ed. New York, API, 1957. 24 p. (Std 9A.)

090 BRITISH STANDARDS INSTITUTION. Cast iron surface plates and granite surface plates for inspection and marking purposes. London, BSI, 1957. 25 p. (BS 817 : 1957.)

090 BRITISH STANDARDS INSTITUTION. Hose of natural rubber with woven fabric reinforcement (special quality). London, BSI, 1957. 7 p. (BS 2860 : 1957.)

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1911. Lab machine helps show way to oil in foothills. Anon. *World Oil*, 1957, **145** (1), 71.—Experiments have been carried out by Gulf to simulate mountain building movements and the formation of traps. Formations are represented by clay in a chamber, mounted on a 5-ft by 5-ft metal table, which has 4-inch high metal sides of double thickness. The sides, sleeved within each other, are also hinged at the corners, and the box can be deformed into various shapes by motor-driven screw shafts at each corner.

The clay is rolled into sheets and placed in the chamber, which is then deformed as required. The clay is moulded into folds, and it may be cut in section to show the structures in 3-dimensions.

The model is being used to study conditions expected in foothills areas. C. A. F.

1912. The oil geology of the United States. J. C. M. Taylor. *Petroleum, Lond.*, 1957, **20** (6), 211–16.—American oil accumulations occurring in every conceivable type of structural and

stratigraphic trap are very widespread, the geological explanation probably lying in vast area of relatively undisturbed rocks of Palæozoic age. The general distribution of strata of different ages is shown diagrammatically. In geological evolution, the pattern of sedimentation has been dominated by 3 major unstable geosynclinal regions—the Appalachian geosyncline in the E., the great Cordilleran geosyncline in the W., and the Gulf Embayment geosyncline to the S. Consistencies in the type of trap present enable the country to be treated as 11 natural provinces, where the same structural and depositional history can be recognized. E. A. G. H.

1913. Sun hits in bay. Anon. *Oil Gas J.*, 3.6.57, **55** (22), 72.—A new field has been found 3½ miles offshore from Chambers County, Texas. It is the sixth field to be found in Galveston Bay since the present exploratory drilling was started in 1956. The new discovery found Frio sand pay and flowed 295 b.d. of 38·7° oil from 8278 to 8288 ft.

Several other wells in the vicinity are being drilled. The area is *ca* 3 miles N. of North Red Fish field found in Oct 1956. C. A. F.

1914. Noelke reef lures oil finders to Irion County. A. P. Wishart *et al.* *Oil Gas J.*, 8.4.57, **55** (14), 171.—The geology and development history of the Noelke Reef (Sixty-seven) field, discovered in Irion County, SW. Texas, in 1956, are described. The reef is Pennsylvanian U. Strawn which was deposited as a shelf limestone on the truncated Mississippian Ellenburger surface. The reef is 263 ft in the discovery well and shows vugular and pin-point porosity in the upper part, with evidence of rapid vertical growth compared with the normal local rate of sedimentation. The first main movements were during the early Pennsylvanian when the Noelke structure was probably first folded; contour maps on the Ellenburger and the Strawn show dome structures.

Permeability of the pay is 20–40 mD, and porosity is approx 9%. Cumulative production to Jan 1957 was 36,990 brl from 2 wells. C. A. F.

1915. Texas Panhandle discovery 35 miles from nearest oil. Anon. *World Oil*, 1957, **145** (1), 78.—There has been considerable leasing in the Palo Duro basin on the W. side of the Texas Panhandle since the recent discovery of oil by Alamosa Ranch 1 in Oldham County. This well on test from 6096–6130 ft found 40° oil from the Pennsylvanian Virgil sand and is the first oil discovery in the basin, although gas has been found elsewhere. Nearest oil production is 35 miles NW. in Hartley County, Texas.

A map shows the location of the discovery. C. A. F.

1916. Key characteristics of Nodosaria embayment. R. P. Grigg. *World Oil*, 1957, **145** (1), 91.—The area of the Nodosaria embayment in S. Louisiana has been undergoing development for some years, but it has only recently been found that there is in this area an abnormal thickening of the older beds of the Frio section. The geology of this area is described, and it is shown that its features have key characteristics which can be applied to other areas to the E. and W.

Beds are Oligocene, and main production comes from the Frio Nodosaria sands. Recent drilling has shown a complex of down-to-the-coast faulting, contemporaneous with deposition, which has resulted in expanded sections of Middle and Lower Frio on the downthrown sides; locally uplift has offset the thickening. New reserves have been found in sands formerly unpenetrated in downthrown fault blocks. Diagrams illustrate the geology of the area, and a stratigraphic table is included. 4 refs. C. A. F.

1917. Pennsylvanian problems in Eastern Oklahoma. C. C. Branson. *World Oil*, 1957, **145** (1), 87.—Problems of sand development in E. Oklahoma, E. of Tulsa County and N. of the Choctaw fault, are discussed. In this area there are complex relationships between the basin and platform environments which influence sand distributions and the presence of stratigraphic traps. One problem is that of the nomenclature of the Pennsylvanian Burgess sand which is locally productive; it is lenticular and is developed on an unconformity surface at the top of the Mississippian. The best-known sand is the Bartlesville, which is also discontinuous and has an imperfect linear pattern parallel to the old shoreline. Other sands behave similarly, but there are also sheet sands of uniform thickness, *e.g.* the Warner, and channel sands such as the Skinner. A diagram illustrates these types of sand bodies on the NE. Ok'ahoma platform.

Problems of source areas and overlaps and unconformities within the Pennsylvanian are briefly noted. A table shows the Pennsylvanian formations for the basin and platform areas of E. Oklahoma. 4 refs. C. A. F.

1918. Southern Oklahoma—a complex geological puzzle. F. P. Schweers. *World Oil*, 1957, **144** (6), 156.—The regional geology of S. Oklahoma comprises a shelving syncline which connects the Ardmore basin with the Anadarko basin. It is shallow and is flanked to the N. by the Arbuckle Mountains. Compression from the N. and S. has led to complex structural and stratigraphical conditions in the area, and examples of almost every type of oil trap are known. Many of the fields have many reservoirs.

Porosity barriers within continuous sands have formed unexpected traps, and truncated, lenticular, and onlapping sands are abundant. It is thought, however, that all the stratigraphic traps have some structural component.

Intermittent movements have caused crests to shift with time, and closure increases with depth in some structures but decreases in others. Examples of stratigraphic and structural traps are briefly noted, and it is suggested that the age of trap formation has an important effect on reservoir productivity. 2 refs. C. A. F.

1919. "Forgotten corner" finds a new target. F. J. Gardner. *Oil Gas J.*, 8.4.57, **55** (14), 169.—The area of the Sweetgrass Arch in N. Montana offers good prospects for stratigraphical traps at shallow depths, but in 1956 none of the 14 wildcats drilled in the area were successful. A recent well, however, 1 Bugbee in Glacier County, found oil in commercial quantities in the L. Mississippian Lodgepole. The zone was fractured limestone at *ca* 4600 ft, and on test the well flowed 25 brl of 36° oil in 1 hr.

Most of the stratigraphical traps found hitherto have been in the regional unconformity at the top of the Mississippian on the flanks and at the crest of the Sweetgrass Arch, and there has been little interest in the deeper L. Mississippian and Devonian in which many shows have been found. C. A. F.

1920. Strat traps lure independents to Illinois. N. S. Morrisey. *Oil Gas J.*, 22.4.57, **55** (16), 177.—Exploration in the Illinois basin is concentrated in searching for stratigraphic traps in the Chester, which are rarely found below 3500 ft. Several pays are usually present in a successful well, especially on the flanks of structures. Re-working abandoned dry holes has been successful, and fracturing has been used to convert marginal wells into commercial producers. Re-evaluating old electric logs has also proved useful, for much of the drilling in the basin has been carried out over the past 20 years, and electric logs with reliable correlations are available for most wells. C. A. F.

1921. Canadian spotlight swings eastward. F. J. Gardner. *Oil Gas J.*, 22.4.57, **55** (16), 175.—Interest in the oil and gas possibilities of E. Canada has been marked during the past 2 years, and a recent well, Bald Mountain 1, near Batiscan on the St Lawrence River, has tested 3½ million cu. ft/day of gas from the Trenton at 8000 ft. There has been active geological

and geophysical exploration in the Quebec Lowlands, and in 1956 at least 3 commercial gas wells were completed in the St John's area. The main area of interest, which lies between Montreal and Quebec, covers 10,000 sq. miles, and geological conditions favour oil and gas fields. C. A. F.

1922. Sinu basin in Colombia may produce new reserves. V. Oppenheim. *World Oil*, 1957, **144** (6), 151.—The geology and oil possibilities of the Sinu basin, which lies between the Sierra de San Jeronimo and the Caribbean coast of Colombia, are described. Beds range from Cretaceous to Pliocene in a section which may reach 20,000 ft. The basin, which covers an area of *ca* 150 miles by 50 miles, is traversed by anticlinal hill ranges which are commonly faulted and thrusted. Surface shows, including mud volcanoes, are abundant, but drilling has been sparse, and only one deep well has been drilled. This was in the Floresanto area and was located in a fault zone.

The main structures of the basin trend SW. to NE., with secondary trends from SE. to NW. In the Floresanto area wells have been drilled on an anticline *ca* 7 miles in length and 1½ miles in width, but a commercial field has not been established.

Sands are well developed in the Tertiary section, and in the Upper Oligocene oil-bearing sands of the Floresanto formation have been found in shallow borings. These sands have individual thicknesses up to 100 ft.

Maps show the location of the basin in Colombia, the surface geology, and structural features. Columnar sections and a sketch cross-section of the Floresanto anticline are also included. C. A. F.

1923. Bolivia oil interest warming up. Pt 1. 3 major oilfields added to concessions listing. E. T. Mauri. *World Oil*, 1957, **145** (1), 183.—Until recently oil development in Bolivia has been largely restricted to the Sub-Andean belt S. of parallel 20°. Recently, however, concessions have been granted to the N. of this area, where sedimentary conditions appear at least as favourable as in the productive areas to the S.

Ca 200 oil and gas seeps are known in the country, and most of these are in the Sub-Andean belt extending for some 650 miles from the Argentine border to the Peruvian border in the N. The discovery of the Campo Duran and Madrejones fields just S. of the Bolivian border in Argentina has encouraged hopes of similar discoveries on the Bolivian side of the border.

Until 1955 the country's oil resources were vested in a government organization, but under a new law, approx 7% of the country has been retained for state development, and the remainder, *ca* 394,000 sq. miles, has been opened up for private interests. 3 major international companies have already applied for concessions, and *ca* 78 million hectares have been applied for under reconnaissance permits. Details of the granted concessions and reconnaissance permits and tax conditions are given. C. A. F.

1924. Desert find reported. Anon. *Oil Gas J.*, 27.5.57, **55** (21), 107.—OM 1, a 5-mile step-out N. of the Hassi Messaoud discovery in the Algerian desert, has reported to have found the Messaoud pay productive up-dip at *ca* 10,725 ft. Pay was 450 ft thick at Hassi Messaoud, with a reported potential of 1800–2500 b.d.

Further wells are being drilled in the area, and 3 tests are being made on the Berraine concession *ca* 120 miles to the NW. C. A. F.

1925. The search for oil in Gabon. V. Houreq. *Bull. Ass. franç. Tech. Pétrole*, May 1957, (123), 217–40.—The interior basin is closed to the S. and open to the NW. Upper Jurassic to Lower Aptian beds are exposed. The beds are lacustrine, rich in pyrobituminous rocks, and with numerous oil shows. The coastal basin is larger, and shows a thin Lower Aptian series surmounted by thick marine Middle Aptian to topmost Senonian. Tertiary has been recognized in wells. There are simple and complex folds and numerous oil shows.

Telluric current studies were made in 1945–46, and a seismic profile (Mabora to Batanga) was shot in 1949. Salt beds created difficulties in interpreting the former, which offered possible indications of salt domes, and appeared unsuitable for examining the deeper part of the basin. The seismic work gave nil to mediocre results. 2 core drill holes gave a little production; subsequent deeper wells had shows. At M'Bilantem well OU 5 gave a little production. Later electrical surveys were made near Port Gentil, and in 1952 seismic reflection work N. of Ogooué gave excellent results in the coastal plains, but less good results on higher ground or where Pliocene sands reach 200 m. A stratigraphic hole at Port Gentil showed 2000 m of Tertiary and at least 1300 m of marine Cretaceous. There were some high dips, and salt was found under the Aptian. Drilling in 1954 revealed a salt dome at N'Daminzé. Seismic and gravity observations were continued, and at Port Gentil a well produced a little oil from a Cretaceous sand at 1280 m. At Ozouri good production was found in fractured silicified Eocene at 700 m on a shallow salt dome. At Pointe Clairetfe gas was found under similar conditions, and oil was found in a Cretaceous sand. Ozouri has 6 producers, and Pointe Clairette a similar number. Sketchy data indicate possible reserves of the order of 4,500,000 tonnes.

There are signs of other salt domes. Possible reservoir rocks range Miocene to Apto-Albian in age.

A number of maps and sections are included. G. D. H.

1926. Classification of the Upper Malm in North-West Germany. (In German.) W. Klingler. *Erdöl u. Kohle*, 1956, **9**, 578–9.—An index fossil table of the Upper Malm is presented, worked out on the guiding profile of well Suderbruch L 48. Through the micropalæontological working of the Malm, assignment of a well-defined cont with exactly comprehensible true index forms has succeeded. Names assigned in the literature have been retained. R. T.

1927. Physical properties of oil reservoir "A." J. Czajkowska. *Nafta* (*Krakow*), 1956, **12**, 176–82.—The oilfield described as "A" yields crude from Ciezkowice sandstone. 3 layers separated by shales are distinguishable, and porosity and mineralogy of the second one is the subject of the article. The paper is fully illustrated and provided with tables. M. S.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1928. 90% reduction in time element for oil surveys. L. G. Fletcher. *Oil Forum*, 1957, 11 (1), 18–21.—The Decca Navigator system, a form of radio aid for determining true geographical positions—first used in the Normandy invasion—is described. This equipment has been used extensively in the marine oil exploration field. It is expected to be valuable in coastal charting. It is applied also to oil exploration in barren and relatively unknown territories. R. T.

1929. Influence of non-cylindricity of structure on the telluric field; study of scale models of resistant anticlines. R. Utzmann and B. Favre. *Rev. Inst. franç. Pétrole*, 1957, **12** (2), 135–44.—Theoretical and model studies have been made of the telluric fields associated with narrow anticlines. The depth of burial, length, and other dimensions were varied, and the results are summarized in graphical form. G. D. H.

DRILLING

1930. How corrosion attracts well casing. Y. W. Titterington. *Oil Gas J.*, 27.5.57, **55** (21), 136.—Corrosion of well casing, which can involve costly repair work, is due to galvanic action, sulphate-reducing bacteria, or stray-current electro-

lysis. The most marked effect is shown by galvanic action, and in parts of Kansas casing leaks have been reported within one year of completion.

Sites of external casing corrosion can be determined from a potential-drop survey, which gives a profile of potential drop down the hole. The operation of these surveys and their uses are described, together with the current requirements for cathodic protection. As well as the standard casing potential-drop profile method of determining current requirements, there has been increasing use of the log-current potential method, which makes a semi-log plot of the solution potential of the well to remote earth for increasing increments of applied current. Examples of the curves are given with a circuit diagram for the log-current method. 5 refs. C. A. F.

1931. Needed—casing strings with yield strengths to 17,000 p.s.i. J. J. Lenker and H. W. Heckathorne. *Oil Gas J.*, 22.4.57, **55** (16), 113.—Increasing well depths indicate that casing strings will be required having yield strengths as high as 17,000 p.s.i. These strengths may be obtained with reasonable ductility by using the quench-and-temper method of heat treating, which is briefly described.

Design factors for casing in deep drilling are given, with tables, and a chart shows the effect of temp on notch toughness for quenched-and-tempered carbon steel and for normalized-and-tempered alloy steel. This shows that the former has improved notch sensitivity at the strength studied. 2 refs. C. A. F.

1932. The continuous dipmeter. Pt 2. J. Grynberg and M. I. Ettinger. *Oil Gas J.*, 22.4.57, **55** (16), 129.—Dipmeter data can be interpreted with a mechanical device, where hole conditions are reproduced on an adjustable table and axis, or by using mathematical and graphical procedures to compute the dip and its direction. These procedures are described, together with the use of polar co-ordinate paper and the stereographic net; apparent dip and strike are calc on the polar co-ordinate paper and these are corrected for hole inclination on the stereographic net. An example is given with diagrams, and a vertical cross-section shows the principle of borehole drift correction. C. A. F.

1933. Investigation results into rotary drilling technique in Poland. W. Paraszczak. *Nafta (Krakow)*, 1956, **12**, 149–52.—Although incomplete, this analysis of results achieved shows that progress is being made along the right road in the development of rotary drilling in Poland. By means of 4 graphs the author represents variation of drilling progress *v.* pressure in various formations, and drilling progress *v.* rev/min of the drill. Theoretical considerations prove correct in practical experiments. M. S.

1934. Mechanical brakes for drawworks on drilling rigs. P. Wolwowicz. *Nafta (Krakow)*, 1956, **12**, 124–9.—The role of brakes is not only to stop the drawworks when they are being raised or lowered, but also to hold the load suspended at any desired level and go into immediate operation in cases of emergency. Although the greatest number of cases involves simply the slowing of a down-going load, this also involves the greatest load in terms of amount of energy dissipated. By means of band or jaws this is converted into heat. A friction-band brake tends to distort the drum and does not dissipate the heat well; apart from that, mechanical failures are possible. A fluid clutch filled with water can take part of the strain. An improvement on the brake design was introduced by bringing in the jaw-brakes, which eliminate the bending moment, affording also independence of the braking action of the direction in which the drum of the brake is rotating and evenness of action due to rigidity of parts. The problems of dissipation of heat and the general safeguards involved in the need for positive and fool-proof engaging mechanism remain to be solved. M. S.

1935. The hydraulics of drilling mud flow. P. W. Cooke. *J. Inst. Petrol.*, 1957, **43** (399), 69–85.—Concerned mainly with the problem of caving in well bores, the author presents calculations which demonstrate that turbulent flow in the annulus is the most effective in the removal of debris. A minimum annular space velocity of 1 ft/sec is required for satisfactory removal of drilled cuttings under conditions of either laminar or turbulent flow. It is suggested that if pump pressure limitations enforce conditions of laminar flow, then the yield value and plastic visc of the mud should be kept to a minimum, and the mud wt should be increased within reasonable limits. 7 refs and 5 pages of discussion. C. B.

1936. Improved method for recovery of barytes from drilling mud. H. Gorka. *Bull. Polish Inst. Petrol.*, 1956, **4**, 6 (Suppl. *Nafta (Krakow)*, 1956, **12**).—Details of a "hydrocyclone" built at the Polish IP which appears to be very efficient. M. S.

1937. Need for drilling mud treating works. J. Gumulczynski. *Bull. Polish Inst. Petrol.*, 1956, **4**, 5 (Suppl. *Nafta (Krakow)*, 1956, **12**).—Treated mud comes as powder from Hungary, but Polish mud from Chmielnik is quite suitable. According to the work done at the Polish IP this mud will disperse with alkalies. Other work was done on the effect of drying, milling, additives, temp, and reconstitution of this mud. M. S.

1938. Differential regulators for drill pipe feeding. J. Raczkowski. *Nafta (Krakow)*, 1956, **12**, 182–4.—Different differential gears used in drilling are described. M. S.

1939. Specific resistance of drilling cores. Z. Jaszczewski. *Nafta (Krakow)*, 1956, **12**, 118–22, 145–8.—The investigation of specific resistance of cores can lead to a better understanding of their composition and porosity. The general formula $\rho = \frac{k \,.\, U}{I}$ shows that attention must be paid to the fact that porous rock conducts mainly by virtue of electrolytes dissolved in it, and the investigations started by the Polish IP in Krakow lab showed that the distribution of pores has a great influence on the result. Maxwell showed that $\rho_{rock}/\rho_{electrolyte} = \frac{3 - f}{2f}$ for rock composed of grains which are spherical and touching, whilst Komarov, for pores of rectangular cross-section and intersecting at right angles $\rho_{rock}/\rho_{electrolyte} = F \,.\, q$, where q varies between 1 and 5 and $f = \frac{3 - \frac{2}{\sqrt{F}}}{F}$. These and other values derived from theoretical investigation are often open to doubt, and for this reason the investigation carried out by the Polish IP was directed at evolving methods of evaluating these. Additional difficulty presented itself due to the fact that a particular specimen of rock may be partly filled with brine and partly with gas or crude. M. S.

1940. The old cable-tool gang. Anon. *API Quart.*, Spring 1957, 2–7.—An account is given of attempts, *ca* 1936, to introduce a combination rig incorporating the best features of both the rotary and the cable-tool drilling systems. The idea was unacceptable, partly on account of the contempt which cable-tool and rotary crews held for each other. Although the American oil industry owes its birth to the cable-tool system, the rotary became a serious competitor with the well at Spindletop in 1901. By 1940 cable-tool rigs were confined almost entirely to E. fields. Confucius described cable-tool wells as early as 600 B.C. Later, drilling by the percussion (cable-tool) method was carried on in various countries. Developments, steel for wooden derricks, casing, steam-powered rigs, etc., are discussed. A new generation of drillers has emerged. Wells drilled for water or brine found oil which

ran to waste into the rivers. In 1859 E. L. Drake drilled for oil and became the founder of the oil industry as we know it, and gained immortality for the cable-tool rig. R. T.

1941. How progress of 2288 metres per rig per month has been attained in drill hole OS-55. L. Szostak. *Nafta (Krakow)*, 1956, **12**, 122–4.—It has been anticipated that extra mud will be required, and additional pumping equipment has been provided; all cleaning equipment has been deepened and widened. Instructions of the Central Petroleum Office have been strictly followed throughout the drilling. A total of 520 m has been drilled, and including logging, stoppages, and repairs it took 216 hr, but exclusive of these, the time taken was 162·1 hr, *i.e.* 2288 metres/month/rig. M. S.

1942. Planning an electronic computer system. L. E. Sandford. *Petroleum, Lond.*, 1957, **20** (7), 249–51.—In oil drilling, the electronic computer can accurately and quickly utilize widespread surveys on surface geological work, magnetometry, seismographic interpretation, etc. Stress is placed on the skill of the operator and justification of the use of a computer in solving particular problems. A graphical illustration is given to show the value of a computer in controlling refinery cost, and a blending study is also cited. E. A. G. H.

PRODUCTION

1943. Do fracture liquids damage productivity? H. K. van Poollen. *Oil Gas J.*, 27.5.57, **55** (21), 120.—Electrical model studies have shown that different fracturing fluids and their additives can reduce the effective permeability of treated formations. The studies indicate that the effect of damage is larger in horizontal than in vertical fractures, and it increases with decrease in fracture size. The decrease in fracture flow capacity results in a lower productivity, but the damage to the formation immediately surrounding the fracture has only a minor effect on productivity. A series of diagrams show the effect of fracture length and bed thickness on productivity, permeability damage, and equipotential lines for horizontal and vertical fractures. C. A. F.

1944. Hydraulic fracturing in Polish oilfields. W. Schiller. *Nafta (Krakow)*, 1956, **12**, 184–6.—Lack of carriers has been the initial obstacle in the attempts to introduce this method into Polish oilfields, so the Polish IP started by preparing Ca-naphthenates to act as emulsifiers. Later more improved and complex emulsions were prepared, ending with RBM (elsewhere called RMB), crude–soap–bunker emulsion consisting of *ca* 62·5% crude, 26·5% bunker, 3% soap, and 8% water. Methods of mixing this with sand are given and followed by analysis of properties of the suspension. M. S.

1945. Fresh water is becoming favourite fracturing fluid. A. Gibbon. *World Oil*, 1957, **145** (1), 76.—Fresh water was first used as a fracturing fluid in the gas fields of the San Juan basin, and has since proved a successful medium in most major N. American fields. The main disadvantage is that, when unthickened, it is a poor carrier of sand, but this can be overcome by using high injection rates. The advantages of fresh water are that it is inexpensive and readily available in most areas, and in some places it can increase permeability by removal of water soluble minerals. Silicate-control additives can be used to combat swelling clays, together with demulsifying agents where needed. Fluid-loss additives have also been used in highly porous beds to prevent excessive bleed off of the fracturing fluid. C. A. F.

1946. Should you fracture water-flood wells? J. E. Wyrick. *Oil Gas J.*, 22.4.57, **55** (16), 118.—The response of wells to hydraulic fracturing is discussed, and the behaviour of 3 water-flood wells subjected to this treatment are analysed with production diagrams. It is concluded that water-flood wells should be fractured, provided the wells are properly chosen and the treatments small. Fracturing is carried out only where there is a discrepancy between amounts injected and produced, and no improvement can be expected if the injection wells will not take water. For initial well completions nitroglycerine shooting is preferred to sand fracturing. In the latter a well is shut in for a few hr after treatment before applying backflow. C. A. F.

1947. Low-cost evaluation of flooding. D. H. Stormont. *Oil Gas J.*, 22.4.57, **55** (16), 140.—A portable water-treating plant has been designed to determine injection water properties in evaluating water-flooding projects in California. The equipment has been designed for use at minimum cost, and includes a complete field lab for microbiological and chemical control, a 10-h.p. centrifugal pump for transferring the raw-water into storage, tanks for unfiltered and filtered water, a pressure leaf filter, and a centrifugal injection pump. A flow diagram is given with photographs of the equipment. C. A. F.

1948. Laboratory investigation of the effect of rate on recovery of oil by water flooding. J. G. Richardson and F. M. Perkins. *J. Petrol. Tech.*, 1957, **9** (4), AIMME Tech. Paper No. 4491, 114–21.—Previous work has led to somewhat conflicting conclusions about the influence of rate of water flow on the recovery of oil by water-flooding. In the new studies clean water-wet sands were used, and the experiments were designed to avoid or minimize disturbing effects. At atmospheric pressure with and without gas present the rates were varied 10,000-fold, and the final oil saturation was found to be independent of water flow rate. At high pressure also the recovery was independent of rate, and when gas was present, or evolved, final oil saturation did not depend on rate.

In scale-model studies of a thick homogeneous sand at low rates water under-ran the oil more than at high rates, although the effect was noticeable only at 0·05 ft/day or less. This affected the break-through recovery slightly, but not the ultimate recovery. For stratified reservoirs the water front lagged most in the finer sand at high rates, leading to break-through at lower oil recovery, but again ultimate recovery did not depend on rate. Free gas increases the tendency to channel through the coarser sand. It also slightly lowers residual oil saturation in uniform sands, and caused early break-through in thick homogeneous sands. G. D. H.

1949. Evaluating D.S.T. data. Pt 3. Use of D.S.T. data in determining reservoir performance. A. J. Zak and P. Griffin. *Oil Gas J.*, 13.5.57, **55** (19), 136.—Drill stem test data can be used to determine the average formation permeability within the drainage area of the well, well bore damage or skin effect, and initial reservoir pressure. Open flow potential can be predicted from fluid recovery data. Shut-in time must be sufficient for the pressure build-up curve to reach a straight line, otherwise the test will be useless quantitatively. As the appropriate shut-in time depends on many factors, records from wells tested in the same area and zone should be examined to determine the ratio of open-flow time to shut-in time.

Limitations of drill stem test data in determining permeability are given, and the effects of well-bore damage are discussed. 2 refs. C. A. F.

1950. Injected liquid propane boosts oil production. A. Gibbon. *World Oil*, 1957, **144** (6), 92.—Gas driven liq propane has been used successfully as an injecting medium in a secondary recovery project in the Seminole area of Oklahoma following exhaustive lab experiments. The reservoir was first repressured with gas so that the liq propane which was injected later did not evaporate. More gas was then injected

to effect the recovery. The technique has resulted in production being increased from 15 to 160 b.d., G.O.R. has fallen from 7000 : 1 to 1000 : 1. C. A. F.

1951. Measurement of bubble frequency in cores. D. R. Wieland and H. T. Kennedy. *J. Petrol. Tech.*, 1957, **9** (4), AIMME Tech. Paper No. 4489, 122–5.—Cores from the Woodbine sand of E. Texas and the San Andres dolomite of the Slaughter field have been used for bubble-formation studies using E. Texas and Slaughter crudes. It was found that definite supersaturation could exist without bubble formation. Frequencies observed ranged from zero at supersaturations below 14 p.s.i. to 3·1 bubbles/sec/cu. ft. of rock at 40 p.s.i. supersaturation. Supersaturations of 19 p.s.i. for E. Texas oil and core, and 25 p.s.i. for Slaughter oil and core were needed before bubbles formed. Changing the type of rock affected the frequency of bubble formation. This could be explained by variation in the surface tensions of the oils and in the surface areas of the rocks. G. D. H.

1952. Pore size distribution of porous media and displacement experiments with miscible liquids. L. J. Klinkenberg. *J. Petrol. Tech.*, 1957, **9** (4), 63–6.—The current concept of pore size distribution is not unequivocally defined, and different methods aiming at determining the distribution will not give the same results. Thus the capillary pressure–saturation method using mercury will cause large pores accessible via small pores to be classed as small pores. Methods employing miscible fluid displacement may give a different impression of pore size distribution, and this point is illustrated by measurements on some sandstone samples. G. D. H.

1953. Evolution of the surface tension characteristics of various wetting agents. C. Labbe. *Rev. Inst. franç. Pétrole*, 1957, **12** (2), 185–206.—Wetting agents are of several types and, depending on their structure and action, may be classed as anionic, cationic, ampholytic, and non-ionic. They may also be oil- or water-soluble. In oil wells they may be used in fracture operations, acidization, emulsion-breaking, and for the removal of water block. In wells they will be under temp and pressures considerably above surface values. This may affect their behaviour, and especially accelerate certain reactions. It is important to consider the effects on the wetting agents of substances which they encounter in the wells or formations, either initially or as a result of reactions associated with the operation being carried out. In some cases the wetting agent may be modified and lose some or all of its effectiveness.

Some lab studies have been made at atmospheric temp and pressures to find the effects on the surface and interfacial tensions of acids and other substances, such as $CaCl_2$, which may come in contact with the wetting agents.

It is important to choose the agents fitted for the operation. Non-ionic cpds may be chemically more resistant, and they may be preferred if their activity is comparable with that of ionic agents. G. D. H.

1954. Frontal drive production mechanisms—a new method for calculating the displacing fluid saturation at breakthrough. L. F. Stutzman and G. Thodos. *J. Petrol. Tech.*, 1957, **2** (4), 67–9.—The displacing fluid saturation at breakthrough is important in determining overall reservoir production. The analysis of saturation and calculation of producing rates are based on the rate equation for linear flow.

$$x_{S_D} = \frac{Q_T - Q_D}{A\phi}\left(\frac{\partial f_D}{\partial S_D}\right)$$

where $f_D = \dfrac{1}{1 + \dfrac{k_0}{k_0}\cdot\dfrac{\mu_D}{\mu_0}}$ is the volumetric fraction of displacing fluid in the flowing fluid.

Material balance applied to the displacing fluid gives

$$\int_{x=0}^{x=(\Delta X)S_{Dx}} [S_{Dx} - S_{Di}]\,dx = \frac{Q_T - Q_D}{A\phi}$$

S_{Dx} is the displacing fluid saturation behind the flood front. Differentiation of the first equation and substitution in the last relationship gives

$$\int_0^{\frac{\partial f_D}{\partial S_D}} [S_{Dx} - S_{Di}]d\left(\frac{\partial f_D}{\partial S_D}\right)_{S_D} = 1$$

To obtain S_{Dx} a plot of S_D is constructed as a function of $\frac{\partial f_D}{\partial S_D}$, and S_{Dx} is located so that the area obtained by graphical integration between S_{Di} and S_{Dx} is unity.

An example of the use of this method is given. G. D. H.

1955. Coalescence in purification of waste waters. L. Bednarz. *Nafta (Krakow)*, 1956, **12**, 190–3.—It may be possible to utilize the variation in surface tension of oil and water for separation of oil from emulsions such as form in the waste waters. Certain slags show a distinct difference in the wetting effect on them exerted by the respective constituents of such emulsions, and so break them. M. S.

1956. Operating costs in oil production. K. Czajkowski. *Nafta (Krakow)*, 1956, **12**, 165–7.—These depend on efficiency of work, ratio of raw material to products or use of cheaper raw materials, full utilization of machinery, economies in administrative costs, elimination of losses and bottlebecks, and finally on full and efficient use of transport with quick turnover. All these are best kept under control by means of " norms " and planning. A list of savings achieved in various branches of the industry and regions is given. M. S.

1957. " RMB " carrier of sand for splitting oil-bearing formations. A. Kwaciszewska. *Bull. Polish Inst. Petrol.*, 1956, **4**, 6 (Suppl. *Nafta (Krakow)*, 1956, **12**).—" RMB " carrier consists of 26·7% bunker oil, 62·3% asphaltic crude, 8% fresh water, and 3% special naphthenic soap. This has the visc of 106 cP/20° C. Method of operation is described. M. S.

1958. Reconnaissance and evaluation of formations by electrical and nuclear diagraphy. I. G. Chombart. *Rev. Inst. franç. Pétrole*, 1956, **11** (11), 1383–90.—The limitations for the satisfactory application of normal and lateral logs to obtain fluid contents and saturations led to the development of techniques using directed or controlled current. These cause the current to flow in a limited band approx at right angles to the well axis for a considerable radial distance. The laterolog has a central electrode with pairs of monitoring electrodes above and below, and one electrode above and one below the other 5 mentioned, and with the same polarity as the central electrode. Spacings of 3, 12, and 16 inches are used, the first being for thin beds.

The guard log has a central electrode and 2 symmetrically placed guard electrodes.

For a laterolog with point electrodes, a non-invaded infinite bed has $R_t = R_a$ over a wide range of R_t/R_m. With permeable infinite beds the apparent and true resistivities are closer the less the invasion and the smaller R_{mf}/R_w. Thin, resistant beds thicker than the spacing have R_a close to R_t.

Both types of log are good for defining highly resistant beds, or marking beds when the mud is very saline.

In the induction log an emitter excites Foucault currents which induce a current in the receiver, and the latter current depends on the conductivity of the zone. The device is well adapted for wells drilled with resistant or oil-base muds. Rocks with moderate or high conductivities can best be investigated by the induction technique.

Quantitative studies are greatly helped by the use of the

micro-log, contact log, and microlaterolog, all employing small spacings. Provided that the mud cake is not thick, the microlaterolog gives an apparent resistivity close to R_m. This combined with R_{mf} makes an estimate of porosity possible.

Logs based on natural radioactivity are suitable for indicating broad rock types, but neutron logs which employ induced radioactivity depend largely on the hydrogen content and the observation of thermic neutrons or γ-rays of capture. Neutron logs will not distinguish between fluids in connected and in isolated pores, and will indicate porosity less well when the formation is clayey. (γ-Ray logs may permit some correction for this.) By taking note of the properties of a larger mass of rock they are superior to micro-logs for rocks with vug or irregular porosity. For current types of apparatus porosity indications fall in reliability when the bed is less than 1–1½ m thick. This depends on the length of the counter, the time constant of the instrument, and the speed of running the device. G. D. H.

1959. Possibilities of the methods of electrical and nuclear diagraphy. M. Martin. *Rev. Inst. franç. Pétrole*, 1957, **12** (2), 145–84.—Using conventional logging devices, a determination of the true resistivity is possible when, among other things, the resistivity and dia of the invaded zone are known. The dia not being measurable, resort has to be made to other devices, and a combination of induction and laterolog can yield useful approx results for the true resistivity. This approach is discussed, together with the use of appropriate curves. For formations with low to moderate resistivities the induction log can be combined with the short normal, and a sonde combining these is in use.

Using appropriate curves and corrections, valuable results can be obtained.

The principle underlying the microlaterolog are described, and its response for various types of formations. The conditions affecting its use are briefly indicated.

If the efficiency of a measuring device is defined by R_a/R it is possible by computation and lab tests to compare the various devices. The efficiency of a device is dependent on the conditions. However, with fresh-water muds it appears that the IL-40 (induction) device is commonly most efficient. The laterolog is more efficient than the IL-40 in deeply invaded formations of moderate porosity and adequate thickness.

Finally, there is a summary indicating the approaches to solving a variety of problems: correlation, detection of porous and permeable beds, quantitative studies under various conditions. Combinations of techniques are noted, and suggestions are made for getting optimum results.

An extensive bibliography is appended. G. D. H.

1960. Fractional balance evaluation of pressure maintenance, Smackover lime gas condensate reservoir, McKamie–Patton field, Arkansas. P. E. Schauer. *J. Petrol. Tech.*, 1957, **9** (4), AIMME Tech. Paper No. 4492, 108–13.—The McKamie–Patton pool is on an anticline 8 miles long, 1–2 miles wide, with a gas cap covering 4000 acres and averaging 90 ft in thickness. 21 wells were drilled on 160-acre spacing, in addition to some black oil wells. Porosity averages 14·2%, air permeability 379 mD, and water saturation was estimated to be 28%. There was no effective water drive. Production of $84{\cdot}3 \times 10^9$ cu. ft. of gas and $9{\cdot}3 \times 10^6$ brl of hydrocarbon liq dropped the pressure from 4409 to 3270 p.s.i.a., and analyses showed that retrograde condensation was occurring in the reservoir. The field was unitized for pressure maintenance, sufficient gas being injected via 3 wells to keep the pressure at 3270 p.s.i.a.

The natural depletion phase behaviour calculations assumed that all production was from the vapour phase of a constant vol reservoir, and that over a particular pressure interval the composition of the entire system changes. The equilibrium conditions at the end of the interval are imposed on a system differing in composition from the initial conditions by the amount of vapour needed to lower the pressure by the required amount.

Injected gas was calculated to revaporize *ca* 85% of the previously condensed liq, while potentiometric studies indicated that 55·5% of the total reservoir vapour would be replaced by injected gas during pressure maintenance. Recoveries were calculated by fractional balance, and a sample computation is given.

The recovery by cycling is estimated to be 42% greater than by a pressure depletion type operation. G. D. H.

1961. Predicted performance of a gas-condensate system, Washington field, Louisiana. J. E. Berryman. *J. Petrol. Tech.*, 1957, **9** (4), AIMME Tech. Paper No. 4490, 102–7.—Gas and liq samples were taken from the first 3 wells completed, when the rate was varied from 0·7 to 3·6 M.M.c.f/day. In the lab the liq and gas samples were appropriately combined, and the pressure-depletion performance determined. The equipment was used as a variable vol system for obtaining the dewpoint and compressibility. The data indicated that the reservoir fluid was at the dew point under original reservoir conditions. Next the system was operated at constant vol, gas phase being removed from the top of the cell into a measuring system, while retrograde liq accumulation was also studied at 300 p.s.i. intervals. Material balance checks on the studies were good. Change in composition of the produced gas was noted. Pentanes plus in the original samples were 66·1 brl/M.M.c.f., and recoveries to 500 p.s.i.g. were 48% of the original amount.

At intervals after production began samples of the liq and gas stream were taken and examined. Calculated and actual recoveries and compositions were compared, and equilibrium vaporization ratios were checked.

In calculating the effect of retrograde condensation on gas phase composition a digital computer was employed. 300 p.s.i. steps were used, and it was assumed that the composition of the gas produced in an interval was equal to that of the vapour phase at the start of the interval. The calculated amounts of retrograde liq agreed well with the lab data. Calculated changes in vapour phase composition on pressure depletion also agreed with lab data. G. D. H.

1962. Sequestering agents for prevention of scale deposition in oil wells. R. C. Earlougher and W. W. Love. *J. Petrol. Tech.*, 1957, **9** (4), 17–20.—If insoluble mineral matter is deposited in the formation near a well or on the down-hole well equipment it leads to lowering of producing rates.

Certain reagents, by inhibiting crystal growth, keep these potential deposits in colloidal suspension, and have been used in boilers, heat exchangers, etc. Briquettes of hexametaphosphate in a water supply tank were found to hinder the scaling up of meters. Later solid phosphate granules were mixed with the sand used in fracture treatments, and were found to have beneficial effects by preventing scale deposition on equipment and in the formation. This type of treatment was observed to give more sustained oil production in one area than did conventional fracturing. G. D. H.

1963. Oil and gas separation is a science. M. S. Worley and L. L. Laurence. *J. Petrol. Tech.*, 1957, **9** (4), 11–16.—Oilfield separators may be vertical cyl, horizontal cyl, or spheres. Each type has favourable conditions for efficient operation. In spite of the considerable masses of fluids handled, the carry-over does not usually exceed 10 p.p.m. of the total throughput. Large vol of liq are removed by gravity settling, but mild centrifugal force may also be used, or impingement-type mist extractors. The knitted wire mesh pads used in some impingement separators give good efficiency for small gas pressure drops.

The physical principles used in separation are outlined. Reference is made to scrubbing and to other techniques.

Particle size, gas velocities, gas and liq densities, and pressure affect the efficiency of separation. G. D. H.

1964. Soviet oil to-day and to-morrow. K. Kellen. *API Quart.*, Spring 1957, 28–31 (46).—On 5 Feb 1957 it was announced to the Supreme Soviet that the ambitious Red Five Year Plan would have to be seriously downgraded, a major factor being inability to cope with ever-increasing oil demand. The Red doctrine of total planning has inevitably meant inefficiency and lack of incentive. In spite of extensive exploration, the Soviet petroleum industry—although able to meet increasing peacetime and industrial demands—seems inadequate to sustain prolonged wartime operations. This is in spite of a 20% increase over 1955. Petroleum product shortages at crit places have hampered plans to expand Soviet economy and modernize the army. Refined products are in short supply; crude oil in storage is in excess. Announcement of an 11% cutback in Soviet war production was due largely to lack of fuel. Soviet strategy for 1957 is to deny Middle East oil to the West, export crude to gain foreign exchange, and concentrate on expanding oil production, refinery, and transportation activities. Oil is extracted in the Arctic and from under the Caspian Sea. The huge Ural–Volga area is reaching peak production. Other producing areas are around the Black Sea, the Donetz basin, Kuibyshev region, Bashkir and Tatar "autonomous republics," and Sakhalin Island. A major bottleneck in U.S.S.R. oil production is transportation. Large 42,000-dwt-ton tankers are being built. Pipeline construction is being increased. Synthetic petroleum is being produced by German experts. Russia's petroleum production is 1,640,000 b.d., compared with 7,151,000 b.d. in the U.S.A. R. T.

OILFIELD DEVELOPMENT

1965. Exploratory costs soar to new highs during 1956. H. J. Struth. *World Oil*, 1957, **145** (1), 62.—Expenditure on exploratory activity in the U.S.A. in 1956 increased to a peak of $2·6 billion, with an average cost of finding oil reaching $1·111 brl. These inflationary trends have continued for some years; since 1951, for example, unit oil finding costs have increased by 61%, whereas crude prices over the same period increased by only 12·5%.

The average cost for an exploratory well in 1956 was $111,092, compared with $92,600 in 1951, and for each successful wildcat drilled last year, 6·8 primary dry holes were also drilled.

It is claimed that, in spite of improved drilling methods and greater efficiency, it is unlikely that there will be any appreciable reduction in the cost of finding oil in the near future. The increasing difficulty in locating fields and increasing costs of materials and wages indicate that the industry is facing a long period of increasing expenditure.

It is estimated that exploration costs during the next 10 years will total $26·6 billion, compared with $18·1 billion during the past 10 years, or an increase of 47%.

Tables show the costs of finding oil in the U.S.A., and reserves, discoveries, and production in the U.S.A. by years since 1936. C. A. F.

1966. World's biggest offshore pool starts feeding new crude line. Anon. *Oil Gas J.*, 22.4.57, **55** (16), 98.—Production has started from the Safaniya field, an offshore field on the W. side of the Persian Gulf *ca* 180 miles N. of Dhahran. The field is *ca* 20 miles by 7½ miles, and produces from the Bahrain zone, a middle Cretaceous sand at *ca* 5300 ft. Crude is 27°, and there are 23 wells, of which 21 are offshore. Production is gathered through a 16-inch submarine line and is passed to Ras Tanura through a line of 140 miles.

A promising structure has been located by geophysical work at Manifa Bay, between Safaniya and the new onshore field at Khursaniyah. C. A. F.

1967. The oil and natural gas industry in Pakistan—the effects of the first Five Year Plan. T. H. H. Skeet. *Petroleum, Lond.*, 1957, **20** (7), 255–9.—Initially the economy of the country is discussed in relation to the considerable imports of petroleum products. After partition the country was left almost destitute of mineral resources, but due to surveys by the Canadian Government and oil companies, sizeable deposits were located. The discovery and production of natural gas at Sui in the W. and Sylhet in the E., has provided indigenous fuel for power stations and iron and steel production. A record of oil production and coal output between 1948 and 1955 is tabulated, and the holdings of the major oil companies are revealed. E. A. G. H.

1968. The French petroleum industry—progress in 1956. Anon. *Petroleum, Lond.*, 1957, **20** (7), 247–8.—Production in France increased by nearly 50% in 1956, offering considerable incentive to refineries. A review of the overall statistics covering production, exploration, equipment, and refining is given. E. A. G. H.

1969. Italian company to explore in Sicily. Anon. *World Oil*, 1957, **145** (1), 186.—E.N.I., the Italian state oil company, has been granted a concession area of *ca* 445,000 acres in Sicily.

Gela 1 in Sicily has found oil and is reported to be producing over 1000 b.d. Additional wells are drilling in the area. C. A. F.

TRANSPORT AND STORAGE

1970. Expansion of oil-loading facilities at Kuwait. Anon. *Fluid Handl.*, 1957, 205–7.—Existing lines at Mina al Ahmadi are being supplemented by a ninth 32-inch gravity line and 4 additional submarine lines in 24 12-inch pairs to form 2 new marine berths. Total loading capacity will be increased to $1·5 \times 10^6$ b.d. Launching of the first of the new 24-inch submarine lines is described. W. A. M.

1971. A 15½-knot tanker. Anon. *Mot. Ship*, 1957, **38** (446), 170.—A plan and description are given of the *Angelos Lusis*, a 17,670-ton, 15½-knot vessel built by Scotts' S. B. & Eng. Co. It has a Scott–Doxford opposed-piston oil engine developing 7300 b.h.p. at full power and 6600 b.h.p. at service power at 111 rev/min. D. K.

1972. Inspecting tanks of oil tankers. A. G. Arend. *Petroleum, Lond.*, 1957, **20** (7), 246.—The hazards associated with draining and cleaning such tanks are discussed, and techniques and equipment which can minimize danger are mentioned. In particular, the utilization of a continuous analyser for revealing if less than 0·2% hydrocarbon vapour is present is described. E. A. G. H.

1973. Trends in oil tanker design. P. A. Medcraft. *Petroleum, Lond.*, 1957, **20** (7), 243–5.—While orders have been announced for tankers exceeding 100,000 tons, the author suggests that the 65,000-ton vessel is the most suitable for long hauls of oil. In a review of the factors influencing present plans, he discusses the possibility of nuclear energy

and other sources of power, in conjunction with engineering, geographical, and economic considerations. E. A. G. H.

1974. Pipeliners don't relax. E. Behrendt. *API Quart*, Spring 1957, 10–15.—Pipeliners look for stronger material. First came wood, then cast iron, steel, seamless steel, and special high-tensile steel. Acetylene and electric welding followed screw joints. After early thin pipelines came 20-inch, 24-inch, and 30-inch lines. 36-inch lines are feasible, provided the pipeliner can trust the metal—" whisker-metal "—steel treated in a vac furnace or made in a solar furnace—or even a non-metallic plastic. Automation will replace all manual labour, cleaning, scraping, etc. Line-walkers are replaced by helicopters, buried pipes defy barnacles in sea water. Automatic batch operation for oil conveyance in pipelines sidetracks bad oil. R. T.

1975. French products line features modern design. J. B. Capdeville. *Pipe Line Ind.*, 1957, **6** (2), 20–4.—A 10-inch dia products pipeline constructed jointly by private capital and the French Government is described. The approx 150-mile line connects refineries in the Lower Seine area with all depots in the Paris region. The capacity is 2,200,000 metric tons p.a. Automatic controls and modern safety devices—in spite of troubles caused by seasonal fluctuations—contribute to distribution eff in conveyance of 32 products by individual batch. R. T.

1976. Phillips remote operation proves reliable and economical. B. E. Ewers. *Pipe Line Ind.*, 1957, **6** (2), 27–30.—Remote control of 7 stations on the 10-inch, 434-mile LPG line from Benedum, W. Texas to Sweeny on the Gulf Coast is described with supporting diagrams. Successful experience with electrical control and telemetering equipment is encouraging for future application. Operation is economical. R. T.

1977. Trans-Canada's coldest crossing is completed. Anon. *Pipe Line Ind.*, 1957, **6** (2), 44–5.—A brief illustrated description of work on Trans-Canada Pipe Line's 2250-mile line. The winter programme includes 2 dual 34-inch crossings of the Assiniboine River made at temp 20° below zero. R. T.

1978. Getting a pipeline across a river. L. M. Odom. *Oil Gas J.*, 1.7.57, **55** (26), 107.—The first of a 3-part article summarizes what has been learnt from experience about breaks in pipeline river crossings, and reasons why fractures do not now so frequently occur are given. Basic problem in proper selection of site, as well as in the design of the crossing of an alluvial river, is knowledge of the river behaviour. G. A. C.

1979. Hydraulics for pipeliners. Pt XXII. Station piping codes and standards. C. B. Lester. *Pipe Line News*, 1957, **29** (5), 36–42.—The uses of American codes and standards in designing station piping, and specifying flanges, fittings, valves, etc., are described. D. B. S.

1980. Unattended pipeline deliveries to a bulk plant. W. D. Lomax and H. W. Walker. *Pipe Line News*, 1957, **29** (5), 43–5.—Refined product deliveries to a small plant are normally made by road and rail tanker from the refinery. In some cases, however, a large pipeline passes near the plant, and an automatic system for tapping products from this line is described. Delivery is controlled from the refinery and transport costs, paper work, and vapour losses are reduced. D. B. S.

1981. Pipeline pressure—surge problems. R. D. Kersten and E. J. Waller. *Oil Gas J.*, 6.5.57, **55** (18), 112.—This is Pt I of a 2-part article, and gives results of a 5-year study of surge phenomena. A pump equation is evolved, and a table explains the use of symbols in the formulæ. G. A. C.

1982. The automatic pipeline. M. T. Nigh. *Oil Gas J.*, 8.7.57, **55** (27), 90.—Pt 1 of the article deals with automation, its economic justification, technical aspects, operation of unattended stations, remote starting control, circuits, pipeline monitoring, telemetering, data logging, tank gauging, and metering.

Pt 2 emphasizes the need to streamline operations, and discusses computers, automatic feedback, p.d. meters, data handling, and need for standardization. G. A. C.

1983. Formula for horizontal flowlines for high pressure crudes. H. C. Collis. *J. Inst. Petrol.*, 1957, **43** (398), 57–63.—Assuming that the gravity of the oil and gas, the gas–oil ratio (G.O.R.) at any temp, and the mean temp are the chief factors affecting the flow of high pressure crudes, general pressure–density relationships are developed using existing p–v–t data. These, in conjunction with the general energy equation, enable an assessment to be made of the flow properties from a minimum of fluid data. Flowline pressures of 200–2000 p.s.i. and G.O.R. of 400–1400 cu. ft/brl at 100° F are covered in the article. 6 refs. C. B.

1984. Problems in underground pipe design and in pipe laying. Pt 3. N. W. B. Clarke. *Pipes & Pipelines*, 1957, **1** (5), 19.—Instructions are given—with supporting illustrations—for pipe laying to attain max effective strength on beds of alternating hardness. R. T.

1985. The Le Havre–Paris pipeline. J. B. Capdeville. *J. Inst. Petrol.*, 1957, **43** (397), 1–13.—After an account of the economic factors which led the French Government to participate in the construction of the pipeline, the author describes its technical characteristics and installation. The pipeline transports aviation fuels, ordinary and high-grade motor spirits, diesel fuels, kerosine, and heating fuels, and the operational and administrative problems which arise from such a large distribution system are described. Details are given of the meters used for measurement of the products, and tests carried out before the transport of special products is permitted are described. 3 pages of discussion. C. B.

1986. What is the answer to unpredictable transit countries? Anon. *Oil Forum*, 1957, **11** (1), 22–3.—The unsettled condition of the Middle East emphasizes the dependence of producer and consumer countries on transit countries. The U.N. *Bull. of Statistics* states that the most economic route for crude petroleum supply to Europe is by Middle East pipeline to the E. Mediterranean, thence by tanker. By this route a ton of tanker capacity can supply *ca* 112 brl/year. From the Caribbean to Europe a ton of tanker capacity carries 70 brl/year. By tanker from the Middle East via Suez the figure is 50 brl/year. Via the Cape route delivery falls to *ca* 25 brl/year. Construction of pipelines depends on political stability. Transport by tanker is flexible, by pipeline more direct. The IPC must decide on pipeline location. The trend to larger tankers and relative transport costs are discussed. R. T.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1987. Extruded plastics for piping. T. R. Irving. *Pipes & Pipelines*, 1957, **1** (6), 25–31.—Sp plastics for piping are discussed—with a supporting table of physical properties—in relation to economics and relative corrosion resistance in chem plant, oil refinery equipment, and effluent drainage systems. P.F.T.E.—working temp range 100° to 250°–300° C—is the nearest approach to a universal panacea, but price limits its use for all but the most rigorous conditions. R. T.

1988. Having trouble with parallel pipe flow? A. J. Paquette. *Petrol. Refin.*, 1957, **36** (3), 219–20.—This article outlines a simplified method for determining the fractional flow in a 2-branch parallel pipe system. The method, which is based on expressing the friction factor as an equation involving both the Reynolds No. and the relative roughness ratio E/D, permits the direct evaluation of flow in each branch. 2 worked examples are given to illustrate the method of calculation. J. R. T.

1989. How to estimate pressure drop in heaters. P. Buthod. *Oil Gas J.*, 1.7.57, **55** (26), 111.—The method presented involves some trial and error, and in the calculation technique a family of enthalpy lines is superimposed on the pressure–temp diagram of the stock being vaporized, making a continuous heat balance possible on the heater while making a graphical integration to evaluate the pressure *v.* length curve. A summary of method steps is provided and a calculation worked out. A brief review is also given of the methods of Dittus and Hildebrand, and of Maker. G. A. C.

1990. New design for process heaters. R. Morrow. *Petrol. Refin.*, 1957, **36** (2), 123–6.—This new process heater design offers a more efficient utilization of costly radiant section tube surface. The principle involved is the double firing of vertically suspended tube banks. A description is given of this type of heater with reference to the heat flux pattern, the heating effectiveness, and the pressure drop through the tubes. Several advantages of the heater, both process and structural, are discussed. J. R. T.

1991. Centrifugal pump packings and seals. H. Woodhouse. *Petrol. Refin.*, 1957, **36** (2), 173–7.—This article outlines the different types of packing used in centrifugal pumps and shows how to determine the correct packing for the service application of a pump. Data on the chemical effect of various gases and liq on packing materials are tabulated. J. R. T.

1992. Cooling water treatment—a review. M. Brooke. *Petrol. Refin.*, 1957, **36** (2), 142–8.—This review discusses many of the problems associated with the use of cooling water in a plant and suggests methods of treatment. J. R. T.

1993. The application of a computer to refinery problems. B. D. Dagnall and P. Mayers. *J. Inst. Petrol.*, 1957, **43** (400), 115–18.—The use of a computer to calculate the optimum operating conditions of a plant, and to simulate the operation of proposed new plant, is described. 4 refs. C. B.

1994. The Government lubricating oil plant in Iraq. Anon. *Petrol. Times*, 19.7.57, **61** (1564), 621.—The plant at Daura, Baghdad, is described which produces a range of oils from high grade motor lubricants to industrial white oils, involving a tonnage of 25,110. The oil refinery was built in 2 years by Foster Wheeler Ltd.

Existing capacity is to be increased to 48,000 b.d. G. A. C.

1995. Developments at Stanlow refinery. Anon. *Engineer, Lond.*, 1957, **203**, 728–30.—Description, with flow charts and photographs, of some of the recently installed plant at Shell Petroleum Co's Stanlow refinery. Total capacity is now 15,000 tons crude/day, and the balanced production includes 60,000 tons of petroleum-derived chemicals p.a. Additional plants incorporated into production pattern are: (1) a Platformer charging light naphtha from Venezuelan, Colombian, and Borneo crudes; (2) an acid sludge decomposition unit, the SO_2 produced being combined with SO_2 from burning of H_2S and S and the whole converted to H_2SO_4 in a conventional plant; (3) an elemental S plant of 20,000 tons annual production based on H_2S from waste refinery gases; (4) an ethane and ethylene plant, using pyrolysis of propane at low pressure and high temp; (5) an *iso*pentane column, feeding light gasoline from the crude dist unit and pentanes recovered from light Platformate; the column is 200 ft high and is equipped with Turbo-grid trays; (6) an "Epikote" resin plant. In addition, a third waste heat boiler has been installed on the cat cracking unit, and various site and maintenance facilities improvements made. A. C.

DISTILLATION

1996. Simplify flash distillation calculations. C. D. Holland and R. R. Davison. *Petrol. Refin.*, 1957, **36** (3), 183–7.—The method given here is based on the rearrangement of the flash equation from the usual form to one containing only one of the 2 possible variables, L and V. With the equation in this form it is readily solved by the use of Newton's method. The application of the method is shown by the solution of 2 illustrative examples. This method is in a good form for digital computer calculations, and it is believed that it surpasses other methods in its ease of application. J. R. T.

1997. Which tower goes where? W. D. Harbert. *Petrol. Refin.*, 1957, **36** (3), 169–74.—In the design of dist systems a frequent requirement is that of separating a single feed stream into 3 or more fractions. This requirement may be met in several different ways, and this paper explains the main principle to be considered, namely, minimum heat requirement, and gives some simple rule-of-thumb methods for choosing the best dist arrangement. J. R. T.

1998. Allowable entrainment at minimum cost. F. A. Zenz. *Petrol. Refin.*, 1957, **36** (3), 179–81.—Minimum cost criterion in terms of allowable entrainment may soon replace the max allowable velocity concept in tower design. The author presents an empirical relationship which defines the entrainment rate at minimum fractionator cost. The minimum cost fractionator should have a design entrainment of 0·175 (L/V), any lower value of this entrainment rate probably indicating that the most economical vessel for the specific capacity has not been designed. J. R. T.

1999. How to design perforated trays. I. Leibson, R. E. Helley, and L. A. Bullington. *Petrol. Refin.*, 1957, **36** (2), 127–33.—A systematic method for design of perforated trays is outlined. Literature data are used to develop new correlations for dry tray pressure drop in terms of percentage perforation area and the ratio of plate thickness to hole dia. Equations for the calculation of static liq seal height from the modified Francis weir formula for rectangular weirs and the calculation of pressure drop for liq flow through the downcomer clearance are described. A detailed example of the application of the design method in specifying perforated trays to replace bubble cap trays at the top of an atmospheric pipe still tower is also given. J. R. T.

2000. Overall and liquid film efficiencies in a Kaskade column. F. H. Garner, S. R. M. Ellis, and E. S. Luxon. *J. Inst. Petrol.*, 1957, **43** (399), 86–93.—Methyl*cyclo*hexane–toluene and methanol–water mixtures were used to determine overall efficiencies of Kaskade trays. A 6-plate dist column was used. A single-plate unit was used for the determination of liq film efficiencies in the desorption of oxygen from oxygen-enriched water by air. The results obtained were used to calculate gas film efficiencies, and conclusions are drawn on the effect of vapour velocity on overall and liq film efficiencies. 16 refs. C. B.

ABSORPTION AND ADSORPTION

2001. How to use absorption factor to keep lean-oil rate down. W. T. Lanz. *Oil Gas J.*, 15.7.57, **55** (28), 88.—A method and correlations are presented for the determination of optimum product recovery at minimum absorption oil circulation. By its use rapid estimates of an oil rate for a new design can be made or the performance of an existing absorber checked. G. A. C.

SOLVENT EXTRACTION AND DEWAXING

2002. Examine solvent dewaxing. Pt I. R. Rautschka, H. Poll, and F. Pass. *Petrol. Refin.*, 1957, **36** (3), 165–8.—A lab study of the factors which influence the dewaxing of mineral oils with solvent mixtures is presented. Apparatus for carrying out the dewaxing tests is described, and the results obtained with several different solvents and oils are discussed. J. R. T.

2003. Design for liquid–liquid equilibrium. J. O. Osburn. *Chem. Engng*, 1957, **64** (6), 322–8.—The method of obtaining the phase relationships for liq–liq equilibrium involving 4 components, *e.g.* use of double solvent or mixed solvent, is discussed. The special case of immiscible solvents, which is the most useful in practice, and the general case of 4-component equilibrium are described, together with the construction of quaternary diagrams and the evaluation of tie lines. D. H. A.

2004. Principles of refining lubricating oil. A. Doll-Steinberg. *Chem Proc. Engng.*, 1957, **38**, 291–4, 327–31.—After a brief survey of the hydrocarbon types present in lub oil stocks, methods of refining them by selecting the desirable and rejecting the undesirable types are considered. Some account is given of commercial processes for solvent extraction and dewaxing, and choice of solvents therefor. W. A. M.

CRACKING

2005. Improve cat cracker feed. G. W. Hendricks *et al. Petrol. Refin.*, 1957, **36** (2), 135–9.—A description is given of a continuous flow bench-scale unifining process for the cat hydrogenation of petroleum fractions. Data obtained from experiments with this apparatus showed that treatment of cat cracker feeds and cycle oils by this method improves both the quality and distribution of the products of cracking. J. R. T.

2006. Blitzing alkylation problems. 6. L. Resen and D. H. Stormont. *Oil Gas J.*, 17.6.57, **55** (24), 130.—Items discussed include insufficient contact in reactor, tips to better operations, and how a West Coast plant operates. The article concludes the series. G. A. C.

2007. Autothermal cracking of refinery gases and butane. J. Reboul. *Rev. Inst. franç. Pétrole*, 1957, **12**, 86–120.—A detailed account is given of experiments carried out at the Gaz de France testing station at Sète on the controlled oxidn (without cat) of residual gases and butane piped thence from the Mobil Oil refinery at Frontignan. 3 types of equipment were used: the Gaz de France P_2 generator, the G.E.I.M. generator, and the Hasche furnace, each being described and illustrated. The first of these operates at high temp and air–gas ratio and produces cracked gas of low cal. val., which must be enriched with the original gas. The G.E.I.M. and Hasche generators operate at lower temp and air–gas ratio, and yield products with higher cal. val.; these, however, contain unstable components, *e.g.* acetylenes, diolefins, which are objectionable. Details are given in tables and graphs of the composition and yield of the products obtained from each generator under various operating conditions and with various feeds. The effect on the products of compression for distribution is considered in detail; compositions and cal. val. of various gas mixtures before and after compression and of the condensates obtained are tabulated. W. A. M.

2008. Experimental study of the accelerating influence of traces of oxygen on the vapour phase pyrolysis of some saturated hydrocarbons. J. Engel *et al. Rev. Inst. franç. Pétrole*, 1957, **12**, 627–44.—Detailed descriptions are given of apparatus and techniques used in static and dynamic studies of the pyrolysis of C_3H_8, *n*- and *iso*C_4H_{10}, and *neo*C_5H_{12}. It was confirmed that addition of traces of O_2 gives an immediate increase in reaction speed. This, however, rapidly falls to normal due to the inhibiting effect of the ethylenic cpds formed, which terminate the reaction chains by capturing free radicals. There were insufficient precise data for the kinetics of the reactions to be worked out in detail. Using the dynamic method, the yield of unsaturated hydrocarbons obtainable from *n*-C_4H_{10} could be increased slightly by injecting the O_2 in several portions along the reaction tube. The improvement over a single injection was again limited by the inhibiting effect of the olefins first formed. W. A. M.

2009. Experiments in the use of heavy unselected fuel oils in the ONIA–GEGI plant at Cahors gasworks. A. Laligand and J. Decaux. *Rev. Inst. franç. Pétrole*, 1957, **12**, 121–9.—Attempts were made to gasify a heavy fuel oil having high Conradson C and asphaltenes and containing some cracked residue. The normal method, whereby liq fuel is injected on to the cat, gave low gas yield and high C deposition. These defects were remedied by prevaporizing the fuel. Results of 2 experiments are tabulated, with comparative figures for the normal fuel charge, and formulæ are derived for calculating yields from Conradson C and carburetting value index (derived from diesel index or visc gravity const, or C–H ratio). Data on the tars produced from the 2 fuels are also compared. W. A. M.

ALKYLATION

2010. Alkylation in the industrial production of hydrocarbon types. R. Jenny. *Rev. Inst. franç. Pétrole*, 1957, **12**, 576–98.—A general survey of industrial uses of alkylation (thermal and cat, liq and vapour phase) begins with a study of the chemistry, particularly the kinetics, of alkylation reactions. Effects of operating variables are shown graphically. Industrial applications are exemplified by descriptions and diagrams of plant and processes for the production of ethylbenzene, cumene, dodecylbenzene, and aliphatic alkylates. W. A. M.

CHEMICAL AND PHYSICAL REFINING

2011. Urea adduction—a process for making light low-pour lubes from waxy crudes. T. H. Rogers, J. S. Brown, R. Dickman, and G. D. Kerns. *Oil Gas J.*, 15.7.57, **55** (28), 107.—The process of 2-step operation involves solvent dewaxing followed by urea dewaxing, and is useful for one-step dewaxing of stocks that contain little wax. In the process

which operates at ordinary temp, separation of mixtures of organic substances is based on the formation of a solid urea complex. G. A. C.

SPECIAL PROCESSES

2012. Winning oil from coal. Anon. *Petroleum, Lond.*, 1957, **20** (6), 217–19.—A short factual account of the £48 million oil-from-coal plant, near Vereelging, S. Africa, utilizing the Fischer–Tropsch process is related. It is situated on top of a vast coalfield, with the present rate of extraction having an expected life of 140 years, and near to the Vaal River, S. Africa's main source of water supply. The coal is gasified with oxygen and steam at 350 p.s.i., and after purification and adjustment of the carbon monoxide–hydrogen ratio is subjected to post-war improved Fischer–Tropsch reactions. Besides producing over 70 million gallons p.a. of motor fuels, 2 series of chemical products emerge, by-products of coal dist and side-products of the synthesis, namely, oxygenated organic solvents. E. A. G. H.

2013. Obtaining pure acetylene from gas mixtures with low acetylene content by continuous gas chromatography. (In German.) P. Benedek and L. Szepesy. *Erdöl u. Kohle*, 1956, **9**, 593–7.—The final gas from partial petroleum oxidn contains 6–8% C_2H_2. Lab experiments in chromatographic adsorption on a moving C bed, in a semi-continuous apparatus, proved successful. On these grounds a pilot plant was constructed as illustrated. From the investigations important parameters were fixed for continuous gas chromatography and optimum working conditions for separating the final gas of CH_4 partial oxidn. Pilot plant results supported the lab and the correctness of calculations for designing the gas chromatography column. Experience gained indicates the val of the process for the wider range of industrial gases. 9 refs. R. T.

2014. Problem of hydrocarbon separation by extractive crystallization with urea. S. Niemientowski. *Nafta (Krakou)*, 1956, **12**, 132–5, 161–5.—The method has become known since 1950, and in 1952 a paper was published by the author. Since then the Silesian Polytechnic (Technology of Petroleum Dept) has taken an interest in this work and the Polish IP has relinquished its investigations. Crystalline complexes form between mol of urea and paraffinic hydrocarbons at 20°–40° C and are decomposed at higher temp into their components. Urea combines with all straight-chain paraffins within a range of mol. wt., chloro-paraffins, and oxy-derivatives as long as they are not branched, the more stable complexes being formed with longer chain hydrocarbons (and derivatives) starting from C_6. With branched-chain hydrocarbons cpds of lesser stability are formed, the stability of C_6–urea being equal to that of 2-methyl-octodecane–urea complex. 10–14 carbons in the straight chain confer stability on a complex of urea with hydrocarbon containing one methyl group. To compensate for C_2H_5 group straight-chain section must equal at least 24 carbon atoms. Br has the same effect as CH_3–, F behaves like H. At higher temp heavier hydrocarbons combine and lighter split off, the former reaction being exothermic, yielding approx 1·5 cal/mol/CH_2=. The ratio of urea to hydrocarbon depends on the No of $\frac{C}{H}$ groups and is given as $m = 0{\cdot}653n + 1{\cdot}51$. Water, alcohols, etc., act as activators. The zig-zag arrangement of straight-chain hydrocarbons allows the urea mol to envelop them in such fashion as to create hexagonal spiral structure along the hydrocarbon which fits inside. Resonance or hydrogen-bond effect is the source of stability of the adduct. The right choice of solvent (or activator) and temp range makes the whole project a commercial possibility, and several papers were presented on that subject at the Fifth Petroleum Congress. At the Leipzig Institute of Organic and Industrial Chemistry equipment built on the lines of the Dousol process operates using urea in water and benzene. The non-aq urea has been successfully applied by Kisielow of the Silesian Polytechnic, but the process is not continuous. Hot solvent extraction of the adduct is described in the papers of the Rumanian Academy of Science. M. S.

2015. Nine producers lead in Britain's 400,000-ton petrochemical trade. Anon. *Oil Gas J.*, 8.7.57, **55** (27), 126.—A review is given of some of the major plants, including the British Petroleum Chemical (B.P.C.) Ltd (which produces ethanol, *iso*propanol, propylene polymer–dodecene, and butadeine–*cyclo*pentadiene); Forth Chemicals Ltd (which manufactures monomeric styrene); Petrochemicals Ltd (which makes a range of chemicals); and Imperial Chemical Industries Ltd.

A table lists Britain's newer plastics, giving chemical classification, manufacturer, trade name, and major applications. G. A. C.

2016. The Fourth British Plastics Exhibition. Anon. *Petrol. Times*, 19.7.57, **61** (1564), 613.—Impressions are given of the first international display and convention, including a review of a paper on the synthesis and properties of olefin and diene polymers.

Output of plastics in the U.K. during 1956 was 344,000 tons, and is expected to rise to 500,000 tons by 1962. G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

2017. Pressure and temperature dependence of the dielectric strength of hydrocarbons. I. (In German.) H. Luther and E. Stark. *Erdöl u. Kohle*, 1956, **9** (9), 601–6.—Investigations—carried out in the illustrated apparatus—on the influence of gas cont on the dielectric strength of some chemically classifiable hydrocarbons are reported. Model substances were employed under controlled conditions to ensure reproducibility of the measurements within acceptable limits. Dependence of dielectric strength on hydrocarbon type and gases dissolved therein and on pressure and temp, was investigated on narrow fractions from paraffins, olefins, alkylaromatics, and alkylnaphthenes. The relative height of the dielectric strength was determined essentially by density and its temp and pressure function, dependent on the hydrocarbon constitution. Type and quantity of dissolved gases scarcely affect the results at normal pressure and room temp. Influence of distance between electrodes was sp for materials. It was weak with alkylbenzenes, with olefins very noticeable. 13 refs. R. T.

2018. Heat transfer rates for gases. F. L. Rubin. *Petrol. Refin.*, 1957, **36** (3), 226–8.—Heat transfer calculations for gases at elevated temp should make allowances for the visc and thermal conductivity of the fluids. Some simplified relationships, such as the Nusselt equation, are not adequate at higher temp. The relationships outlined in this article involve the Prandtl No. raised to the one third power and the visc ratio raised to the 0·14 power. J. R. T.

2019. Polar diagrams speed cooler-condenser design. G. H. P. Bras. *Petrol. Refin.*, 1957, **36** (2), 149–54.—A new method for the design of cooler-condensers for gas–vapour mixtures is

presented. The tedious and time-consuming trial and error computations of the Colburn–Hougen design method are replaced by a graphical procedure and the application of a polar diagram, for the determination of the gas–liq interface conditions. The polar diagram is applied to 2 design examples of cooler-condensers. The deviations of the total calculated tube surface as compared with the Colburn–Hougen method are +0·2% and −2·0% respectively. J. R. T.

2020. Antioxidant properties of some alkylphenols. G. Parc. *Rev. Inst. franç. Pétrole*, 1957, **12**, 304–29.—In the first part of the paper the need for oxidn inhibitors in cracked gasoline and their general characteristics are briefly surveyed. There follows an outline of the mechanism of liq phase autoxidn of hydrocarbons, stressing the importance of chain reactions involving free radicals. The mode of action of various inhibitors in terminating the chains is discussed, the case of 2,4,6-trialkylphenols being considered in detail, and finally the literature on the relation of the structure of alkylphenols to their inhibiting power is reviewed. The second part of the paper is expt. Details are given of the preparation and physical properties of 23 alkylphenols. The inhibiting effects of these and other cpds (altogether 29 phenols, 2 aminophenols, and one *p*-phenylenediamine derivative were used) were evaluated by dissolving 5, 10, and 20 micromol/100 cc in a reformed cracked gasoline, the composition and characteristics of which are given. The results are tabulated, the criterion adopted being the 16-hr ageing gum. Conclusions drawn include: (1) inhibiting power increases in passing from mono- to di- to 2,4,6-trialkylphenols; (2) in 2-methyl-6-*tert*-butylphenols the effect on the inhibiting power of a substituent *p*- to the OH is, in decreasing order: NH_2, CH_3, H, Br, NO; (3) in 2,6-di-*tert*-butylphenols the order of merit of *p*-substituents is: CH_3, *tert*-Bu, Br; (4) in 2,6-dialkyl-4-methylphenols the presence of a *tert*-Bu group in one of the *o*-positions is beneficial, the second *o*- group having, in general, a minor influence; the presence of a *tert*-amyl group *o*- to the OH is unfavourable; (5) trialkylphenols are not as good antioxidants for cracked gasoline as aminophenols or *p*-phenylenediamine derivatives. 51 refs. W. A. M.

2021. Liquid–vapour equilibria between acetone, *iso*propanol, and water. B. Choffé and L. Asselineau. *Rev. Inst. franç. Pétrole*, 1957, **12**, 565–75.—Expt data reported previously (*cf.* Abs. **88**, 1957) are shown to be in agreement with the laws of thermodynamics. W. A. M.

2022. Physical properties by nomogram. F. W. Winn. *Petrol. Refin.*, 1957, **36** (2), 157–9.—A nomogram is given by means of which the following properties of petroleum fractions may be established from a knowledge of any 2 of them: mean average b.p., mol. wt., latent heat of vaporization, pseudo critical pressure, aniline point, characterization factor, gross heat of combustion, and the C–H ratio. J. R. T.

2023. Get your K's by nomogram. H. S. Myers and J. M. Lenoir. *Petrol. Refin.*, 1957, **36** (2), 167–71.—A nomogram is presented for the evaluation of the equilibrium ratio K, which is applicable to all types of hydrocarbons over a wide range of pressures, temp, and convergence pressures. It is comparable in accuracy to any of the current methods for predicting equilibrium ratios, and has the great advantage of being simple and fast to use. J. R. T.

2024. Nomogram: solubility of water in hydrocarbons. D. S. Davis. *Chem. Proc. Engng*, 1957, **38**, 341.—Nomogram is given, based on linear relationship between log (solubility of water in mol %) and 1/°R, covering 0–10 mol % of water, temp 40°–400° F, for 16 hydrocarbons, 2 naphthas, and one lub oil. W. A. M.

2025. Water dissolved in hydrocarbon fuels. P. L. Davies. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 427–39.—The solubility of water in hydrocarbon fuels at ordinary temp is very small and for most practical purposes negligible. However, occasions do arise when even such small quantities of water can be a source of trouble, and the study of soln of water in hydrocarbons becomes important. A new experimental method is described for determining the solubility of water in hydrocarbons. This method, in principle, measures the absorption of water from a saturated atmosphere. A theoretical study of the solubility of water in hydrocarbons suggests that Henry's law is obeyed and that the logarithm of the water solubility in a hydrocarbon is proportional to the reciprocal of the absolute temp. The latter relation has been shown to be true experimentally for a number of pure hydrocarbons and a hydrocarbon fuel, the information being obtained from the literature. These data have been used in conjunction with the thermodynamics of soln to explain differences in the solubilities in terms of the intermolecular and thermal energies of water in solution in hydrocarbons. Practical solubility data on hydrocarbon fuels show that the water dissolved in them is much less than one would expect from the study of pure hydrocarbons. A tentative explanation of this effect is offered. (Author's abstract.)

2026. Viscosity–temperature index scales (VTI). C. M. Larson and W. C. Schwaderer. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 189–212.—Modern petroleum research and development programmes, as well as practical marketing considerations, require a more suitable method of expression than the Viscosity Index (V.I.) and the Pole Height. None of the many other proposed systems are wholly satisfactory. 32 systems previously suggested are listed. In response to resolution No. 10 passed by the Third World Petroleum Congress, expressing the need for an improved index for visc–temp relation, the authors propose an index for which the name "Viscosity–Temperature Index" (VTI) is suggested. 2 Viscosity–Temperature Index Charts (A and B), illustrating 2 variants of the VTI scale, are presented. The VTI scales retain the popular and widely recognized numbers of the Viscosity Index from 0 to 100, and also retain the *L*-Series values, which represent 0 (with the suggestion that *L* be modified to give a straightened *L*-series). The 100 value or upper limit of the scale is represented by *P*, the "perfect" or ideal oil, the visc of which is independent of temp. For this unchanging visc, the new expression "Permanent Viscosity" was coined. It is shown that: (1) anomalous values are avoided; (2) the sensitivity of the scale remains the same; (3) non-hydrocarbon materials, as well as synthetics and hydrocarbon oils, are equally covered—the latter being subjected increasingly to extensive processing and synthesizing, thereby reaching high index figures; diesel fuels, kerosines, gasolines, and water can be included; (4) the visc–temp relation of all lubricants and fluids are expressed in per cent of *P*, the perfect oil having "Permanent Viscosity."

VTIc, the third and final variant of the VTI scales, is presented in 2 charts (C_1 and C_2). A straightened *L* (VTIc°) is used. It is shown that: (1) parallel values to the accepted V.I. (0–100) are obtained, thereby making the V.I.—modified by a straightened *L*—part of the VTIc, while extending its application to the greatest possible limits; (2) constant values are obtained for the different fractions into which lub oil from any one source may be divided, thereby maintaining their family characteristics; (3) constant values are obtained for any 2 set temp. Chart C_2—erected for 32° and 100° F—makes possible the study of the visc–temp behaviour of very light fluids, including water and gasolines; (4) the VTIc scale maintains all the virtues enumerated for the VTIa and b scales in Pt I and also expresses the visc–temp relation of all fluids in per cent of *P*, the perfect oil having "Permanent Viscosity." (Authors' abstract.)

2027. Contributions to the chemistry of higher hydrocarbons. (Studies on German dewaxing residues.) W. Fuchs. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 179–87.—Upon suggestion of the German petroleum industry, the composition of dewaxing residues of the Emsland crude has been investigated. The composition of petrolatum is complicated, but can be described. The waxy part of spindle oil has been found to contain mostly *n*-paraffins and a minor fraction of naphthenes. The wax extracted from heavy machine oil contains mainly branched naphthenes, *ca* 40% *n*-paraffins of high mol. wt., and some resins. The chromatographic column has been modified so as to be composed of a sequence of various adsorptive agents. Thus, it became possible to separate a mixture of hydrocarbons, first, according to type (aliphatic and naphthenic), and then, within each type according to mol. wt. Isomerization, formation of olefins, and chlorination have been studied as methods of possible utilization of various products. Suitable chlorination gave up to 41% monochlorinated products. The yield in products with terminal chlorine exceeds considerably the prediction of the Hass–Asinger distribution. The formation of chlorinated paraffins with terminal chlorine depends upon temp. The content in primary $C_{24}H_{49}Cl$ upon chlorination of *n*-$C_{24}H_{50}$ amounts to 7·4% at 50° C, 15·8% at 100° C, 25·8% at 150° C, and 31·5% at 200° C. (Author's abstract.)

2028. C_9 and C_{10} alkylbenzenes and aromatic olefins in the products of thermal aromatization of naphtha. E. Gil-Av *et al. Proc. Fourth World Petrol. Congr.*, 1955, **5**, 173–7.—The individual C_9 and C_{10} alkylbenzenes and aromatic olefins of the 150°–190° C cut formed in aromatizing cracking of naphtha were determined. The aromatic olefins were converted by mild cat hydrogenation to the corresponding alkylbenzenes and determined by difference. Alkylbenzene analysis was made possible by a combination of silica gel, adsorption, fractional dist, and i.r. analysis. 65% of the cut was accounted for in terms of 30 individual hydrocarbons. The abundance of the individual C_9 cpds is compared with thermodynamic data. (Author's abstract.)

2029. Some high-pressure properties of model substances and petroleum hydrocarbons. E. Kuss and G. R. Schultze. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 101–17.—The visc of 2 linear dimethyl–siloxane polymers (mean mol. wt. 8800 and 30,500) and of several esters of *ortho*-silicic acid have been determined at 25°, 40°, 60°, and 80° C, up to 2000 kg cm^{-2} of pressure. For high-polymer silicone oils the visc is strongly dependent upon chain length, but the dependence of visc upon pressure is almost independent of the degree of polymerization within the region investigated. The pressure dependence of visc increases greatly with the chain length for esters of *ortho*-silicic acid in an analogous manner as was found for hydrocarbons. Ring groups within the mol bring about a very considerable influence of pressure upon the visc. The system acetic acid–water was investigated as being representative of a chemically well-defined mixture with a max of visc at a definite concn. As the pressure increases, the max of visc becomes more pronounced. However, the pressure coeff of the relation does not show any extreme value, neither max nor minimum, within the entire region of concn. For the system *n*-butylalcohol/decahydronaphthalene, which is representative for a mixture with a minimum of visc at a definite concn, the coeff does not reach an extreme value over the entire range of concn. Polished metal surfaces, which were exposed to pressures up to 10,000 kg cm^{-2} under oil, showed characteristic changes of their structure if the pressure was suddenly released. The effect was verified in several ways using a metal microscope and an electron microscope. The roughening of the surface was confirmed with a Forster–Leitz surface tester. Arc spectrograms proved that metal particles had been ejected from the metal into the surrounding liq. Alloys show this effect more pronouncedly than pure metals. No final explanation can as yet be presented, but several possibilities are discussed. (Authors' abstract.)

2030. Oxidation of mineral oils, effect of ozone on the oxidation stability. F. Pass, H. Poll, and J. Zartl. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 87–99.—The paper gives a survey of the anti-oxidants based on their various effects. The main types of oxygen absorption curves are illustrated, and the influences responsible for the formation and the changes in the configuration are explained. The effect of ozone on various mineral oils is described in detail, and the change in the oxygen absorption curves resulting from this treatment is illustrated. From the changes of the oxygen absorption curves of any oil, distinguishing indications of the basic oxidn characteristics of the original oils can be defined. The activation of oxidn retardants, which occur naturally within the oil itself, is probably the cause of these changes. A reaction mechanism for this activation reaction is suggested and substantiating evidence presented. Ozone influence on inhibited oils shows that the inhibitor is consumed first, which makes possible the evaluation of the oxidn characteristics of the original oil. Retardants formed by ozone treatment seem to be effective as additives to another non-ozonized oil, in which they improve, considerably, the oxidn stability of the entire blend. (Authors' abstract.)

2031. Science and technique in Soviet Union—gas–liquid reaction in foam. M. E. Pozin. *Nafta* (*Krakow*), 1956, **12**, 135–8.—So far gas–liq reactions have been carried out by means of exchange through films, droplets, or bubbles. The first 2 methods are not very fast. The third, more intense, reaction requires more energy. By providing more turbulence, and so more frothing and emulsification, the system becomes unstable and the interphase contact area is increased. The speed required for such state is between that for bubble towers and atomization: mixed with foam some droplets appear, but there are no streams of liq. In actual fact it is impossible to get either of the 3 states without the appearance of the others. " Mesh " plates are most effective in obtaining foams, but the system at " bubble " stage may, with increase of gas velocity, go over straight to spray state. Foam should form at 1·0–1·3 m/sec, gas velocity should in any case be more than natural buoyancy of the bubbles, best results being obtained when ratio of buoyancy of foam and gas is greater than $\frac{1}{2}$ and often nearly 0·9. At gas velocity of 3–4·5 m/sec spray begins to form. In bubble towers material and heat exchange take place within the thin layer on and above the plate, whilst in foam towers it takes place all through the foam. Distances between plates should be large, occasionally one plate will suffice; No. of plates n = log (1 − efficiency of the apparatus)/log (1 − efficiency of one plate). L/G can vary within large limits. A graph of the height of the foam in relation to the gas velocity at various initial heads of liq is given. In conclusion, it is claimed that the foam-filled tower will work more efficiently than a packed tower. M. S.

2032. The application of digital computers to problems of process development in the petroleum industry. J. T. Ahlin. *J. Inst. Petrol.*, 1957, **43** (400), 111–14.—After a brief discussion of the advantages that electronic computers offer to the process engineer, the paper describes their application to the problems of process development. It is stressed that the use of computers enables the process engineer to correlate relationships between variables far more systematically than hitherto possible, and examples are given of the application of computers in lab analysis, pilot plant operations, process design, finished process performance studies, and unit improvement in operation and design. C. B.

2033. The use of ozonolysis in oil constitution research. H. Boer. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 1–12.—Ozone is one of the very few reagents that cleaves an aromatic nucleus without at the same time destroying its substituents. It is shown that the combination of ozonolysis and vapour-phase chromatography may be applied to the analysis of polyalkylbenzene mixtures with satisfactory results. A technique is described to convert the products of the reaction between ozone and polyalkylbenzenes into volatile fatty acids; in this way, each aromatic carbon atom is recovered in the form of a carboxyl group. These acids are identified by vapour-phase chromatography; an improved method is given to analyse quantitatively mixtures of the 9 C_1–C_5 acids. Examples are given of the determination of the identities and numbers of total side-chains occurring in polyalkylbenzene fractions of petroleum. Preliminary results which have been obtained by extension of the method to condensed aromatic–naphthenic cpds are reported. The method compares favourably with spectroscopic methods in that it is applicable to higher boiling fractions and is less time-consuming.
(Author's abstract.)

ANALYSIS AND TESTING

2034. Review of American Petroleum Institute Research Projects on composition and properties of petroleum. A. E. Miller. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 27–86.—The API Fundamental Research Programme was initiated in 1925. The programme functions through research projects which were divided in 1931 into 2 categories: one on the occurrence and recovery of petroleum, and the other on its composition and properties. The projects in the second category report to the Advisory Committee on Fundamental Research on the Composition and Properties of Petroleum (ACFRCPP). All information developed by the programme is dedicated to the public through publications. The 7 API fundamental research projects of the ACFRCPP on the composition and properties of petroleum are a well co-ordinated effort of considerable scope and magnitude.

API Research Project 6 has isolated and identified 141 pure hydrocarbons from one representative petroleum. Another function is the purification, packaging, and certification of 2 series of standard hydrocarbon samples now numbering 226. API Research Project 42 has synthesized 224 hydrocarbons of high mol. wt. It determines many physical properties of these hydrocarbons and develops correlations of their chemical structure with their physical properties. API Research Project 45 has synthesized 287 hydrocarbons and other cpds of low mol. wt. APIRP 45 supplies most of the hydrocarbons purified by APIRP 6 for the standard hydrocarbon samples. This project also tests pure hydrocarbons in engines and has developed many important correlations of hydrocarbon type and structure with engine behaviour. API Research Project 44 compiles data on the properties of hydrocarbons and related cpds. Tables of the physical and thermodynamic properties and catalogues of spectral data are compiled in usable form for the industry. API Research Project 50 contains additional information on properties of hydrocarbons and related cpds from petroleum. It carries out most of the statistical, mechanical calculations of thermodynamic properties from mol structure data for the APIRP 44 tables. API Research Project 48 studies sulphur cpds in petroleum. It has isolated and identified 43 sulphur cpds from one representative petroleum. APIRP 48 has also synthesized 25 sulphur cpds believed to be in petroleum. The physical and thermodynamic properties of these pure cpds are determined and standard sulphur cpd samples prepared. API Research Project 52 will extend the study of petroleum to its nitrogen cpds. It will obtain information on nitrogen cpds comparable to that secured by APIRP 48 on sulphur cpds.

The API fundamental research on composition and properties of petroleum has cost the petroleum industry around 3½ million dollars to date. The programme is kept up to date and virile through the constant attention of the Project Advisory Committees. As a result of this programme we have advanced far in our knowledge of the composition and properties of petroleum. There is still much more to learn, and all connected with this effort look to the future with confidence and enthusiasm. (Author's abstract.)

2035. Review of new developments in analytical chemistry. E. L. Baldeschwieler. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 235–50.—Recent progress in the analytical field has been in the development of techniques and procedures for more rapid analyses, improved accuracy, and the evaluation of constituents which could not be heretofore determined. Many new techniques have become available in the past few years. The most important advances have been in instrumental methods, organic precipitants, separation techniques such as chromatography, and entirely new tools such as radioactivation. Applications of many of these newer techniques to the solution of industrial problems are discussed, with particular emphasis on their use in the petroleum field. A tabulation showing a comparison of the detection sensitivity for a number of elements, when using colorimetric, emission, and radioactivation methods, is included. The time savings obtained by the use of modern analytical procedures are shown. The analytical problems and requirements of industrial lab are discussed. (Author's abstract.)

2036. Hydrocarbons from petroleum. API Project 6. Anon. *Petrol. Times*, 19.7.57, **61** (1564), 615.—Dr F. D. Rossini's lecture, London, July 1957, describing the work and achievements of the project on the analysis, purification, and properties of petroleum hydrocarbons, of which 159 pure substances have been isolated and identified, is reported.
G. A. C.

2037. Petroleum. R. L. Le Tourneau. *Analyt. Chem.*, 1957, **29**, 684–97.—A comprehensive and selective review of the literature on the analysis and testing of petroleum. 522 refs.
J. S.

2038. Review of modern methods of chemical analysis. G. Chatelus. *Rev. Inst. franç. Pétrole*, 1957, **12**, 599–626.—A second bibliographical survey brings the author's previous review (*cf.* Abs. **1809**, 1954) up to date. As before, the first section deals with general, inorganic, and organic aspects, the second section being devoted to analysis of petroleum products. 540 refs.
W. A. M.

2039. Philosophy and practice of lubricants quality control. J. H. Harris. *Inst. Petrol. Rev.*, July 1957, **11** (127), 175.—The organization of testing and acceptance of non-petroleum components of oils, blending of finished products, and blending control are discussed, together with techniques of grease testing. Consumer specifications are discussed, and tables give typical tests for non-petroleum components, ball and roller bearing rig tests, and customers' specifications for various SAE oils.
G. A. C.

2040. "Parafinoskop J.P.1"—apparatus for determination of critical temperature of paraffin wax precipitation from crude oil in reservoir conditions. J. Pohl. *Nafta (Krakow)*, 1956, **12**, 152–4.—All reservoir parameters must be known before optimal conditions of exploitation can be achieved. An autoclave sampler was developed by the Polish IP in 1948 and perfected during the following 8 years. It is described with operational details, with 2 diagrams and a photograph in the text.
M. S.

2041. Cetane numbers—their determination and significance. The Ignition Quality of Diesel Fuels Panel of IP Standardization Sub-Committee No. 5. *J. Inst. Petrol.*, 1957, **43** (398), 64–7.—Methods for the determination of C.N. at present in use in the U.S.A., Great Britain, and Germany are described and their limitations discussed. A programme of co-operative testing was arranged by German and British lab, and results indicate very good agreement. The effect of the different test engines on cetane rating is discussed, and a working group has been set up to study ways of improving precision. 3 refs. C. B.

2042. New fractionating techniques for heavy petroleum products. M. Bestougeff and D. Bargman. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 213–34.—A scheme of complete chemical analysis for heavy petroleum residues and for bitumens has been developed. By employing this method and new fractionating techniques it has been possible to separate and identify several distinct classes of components of these products. In particular, the method of gradual precipitation, the chromatographic, and the fractional crystallization techniques have been improved. The paper gives several examples of processes used. Separation of sulphur cpds has also been studied. Crystalline sulphur cpds have been discovered and separated, starting from solid hydrocarbon mixtures from Middle East petroleum residues. A preliminary study has been made of the u.v. and i.r. spectra (6–15 μ) of the most complex components. (Authors' abstract.)

2043. National and international standardization relating to methods of testing petroleum products and to the measurement of bulk quantities. H. Hyams. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 251–69.—The paper indicates the petroleum testing methods and oil measurement procedures recognized and used in *ca* 70 countries from which the information was obtained. Information is also given regarding national standards bodies, where these exist, and the extent to which they, or other local associated bodies, participate in the production and presentation of standard methods for testing and measuring crude oil and petroleum products. The need for international rather than national methods and procedures is emphasized. Unilateral amendment of methods such as those published by the American Society for Testing Materials (ASTM) and the Institute of Petroleum (IP) is deprecated. The need for strengthening and making wider use of Technical Committee No. 28 (Petroleum Products) of the International Organization for Standardization (ISO/TC28) is emphasized. This in turn would benefit all concerned with quality and quantity control over petroleum products purchased and sold, domestically and internationally. (Author's abstract.)

2044. Standardization of Belgian methods of sampling and testing of petroleum products. F. P. Malschaert. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 283–98.—Up to 1954 the analysis and sampling of lub oils and greases had to be effected in line with specification A.B.S. No. 52, which dates back to 1933. For the numerous methods not contained in this specification and for the analysis of products other than lub oils and greases, lab are resorting to their own techniques or one of the many processes standardized in other countries. The Institut Belge de Normalisation has requested the Société Belge pour l'Etude du Pétrole to resume study of the methods entailed in specification A.B.S. No. 52, and submit proposals for standardization of all other methods of analysing petroleum products which may appear worthy of attention. The S.B.E.P. Committee has carried out its task with full respect for the spirit of the convention, binding the Institut Belge de Normalisation (I.B.N.) and the equivalent Dutch Institute (H.C.N.N.) and acting along lines suggested by the I.S.O.T.C. 28 Committee. The outcome of this work is a set of Belgian standards (N.B.N.), many of which are directly based on foreign standards widely adopted by all petroleum engineers. The Research Committee on the S.B.E.P. and the I.B.N. believe they have made an important step towards standardization on an international scale of analysis and sampling methods for petroleum products. (Author's abstract.)

2045. Automatic apparatus for sulphur determination by quartz tube combustion. E. Weisang. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 299–306.—An apparatus is described for sulphur determination in hydrocarbons, developed at the lab of Compagnie Française de Raffinage. By such an apparatus quartz tube combustion is carried out automatically. Automatization of the combustion is achieved through heating the sample to be analysed at a predetermined rate. The apparatus is of real importance to testing lab, since combustion takes place without requiring the operator's care. Results obtained are more accurate than those specified by IP standards. (Author's abstract.)

2046. Apparatus for the rapid and precise ebulliometric determination of molecular weights. A. J. Davies, A. E. Phillpotts, and B. W. Swanson. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 351–70.—An apparatus for the rapid and precise determination of mol. wt. by the ebulliometric method is described. It employs Thermistors as electrical resistance thermometers and achieves a thermometric lag some 10 times less and an accuracy some 5 times greater than those of Beckmann thermometers. Evidence is given that a useful proportion of commercially available Thermistors have the stability requisite for this application. (Authors' abstract.)

2047. Ultrasonic velocity, as related to other physical properties, in the structural group analysis of petroleum products. M. Baccaredda and E. Butta. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 383–90.—General information is first given about methods of structural group analysis for petroleum products, and special consideration is given to the determination of the mean branching's degree through the measurement of the surface tension and the calculation of the specific parachor. The ratio between the specific parachor and the specific ultrasonic mol velocity (given by $\frac{\sqrt[3]{u}}{d}$, where u is the ultrasonic velocity and d the density) was previously found to be constant in pure hydrocarbons with different degrees of branching and with different mol constitution; the same result is now proved to hold also for complex mixtures of saturated hydrocarbons. It is therefore possible to employ, instead of the surface tension measurement, the measurement of the ultrasonic velocity in order to determine the mean degree of branching of hydrocarbon mixtures. The ultrasonic velocity method seems to be particularly convenient for products containing impurities which may affect to a great extent the surface tension, because the ultrasonic velocity is much less affected by them. Moreover, the ultrasonic velocity can be measured with very great accuracy by optical methods. (Authors' abstract.)

2048. The continuous determination of water in crude oils by dielectric constant. C. Guyot. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 391–401.—A continuous recording meter based on dielectric constant measurement has now been in use in various types of water gauging operations for some months. The paper gives a description of the latest type of instrument and an account of the results obtained with it in comparison with water determination by conventional methods. A brief account of the application of the meter to the continuous recording of the toluene content of toluene concentrate is also included. (Author's abstract.)

2049. Analysis for trace materials in the petroleum industry. H. Levin. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 441–7.—It is surprising how extensive and numerous the problems are in the petroleum industry where trace constituents are important considerations. They are involved in full-scale production operations as well as in petroleum research. The effects of trace constituents in a single large petroleum refinery may run into thousands of dollars per day. Many trace constituents are objectionable, but others are sought because they act as promoters of desired reactions or properties. Some trace materials are temporary poisons to cat, others are permanent. Some trace constituents are objectionable because of their direct monetary value, while others are objectionable because their presence interferes with the economical conduct of a manufacturing process or a manufactured product. This paper not only explores the various phases of the petroleum industry and petroleum research where trace constituents are important, but also surveys uniquely applicable or interesting methods for making the necessary analytical determinations. (Author's abstract.)

2050. A differential refractometer for precision measurements. (In German.) O. Bottmann. *Chem. Ing. Tech.*, 1957, **29**, 468–72.—The principle, construction, and operation of a differential refractometer capable of measuring differences in refractive index in the range $0<\Delta n<4 \times 10^{-3}$ to $\pm 2 \times 10^{-7}$ is described. Relative accuracy is $\pm 0{\cdot}05\%$ and absolute accuracy $\pm 0{\cdot}1\%$. The instrument may be used for normal refractive index work and for measurements in the range $1<n<1{\cdot}55$ an accuracy of $\pm 3 \times 10^{-5}$ may be obtained. P. J. K.

2051. Identification and determination of impurities and additives in petroleum products. C. Alexanian *et al. Proc. Fourth World Petrol. Congr.*, 1955, **5**, 403–25.—Of the subjects dealt with in the lab, the following have been chosen: identification and determination of natural and artificial impurities in petroleum products, of dopes and additives for gasolines. The important part played by vanadium in petroleum chemistry demands both of the consumer and the research worker a knowledge of convenient research and determination methods. The authors have submitted a review of colorimetric analyses which seem best to answer these purposes The Kolthoff and Matsuyama polarographic method of determination for aluminium alloys were used to make an analysis of iron, copper, lead, and zinc in oil ash. The prospects of arc or spark spectrometry were also investigated. The authors then give examples of the use of the flame spectrometer which, while being a simpler method, covers a smaller range of investigation. The spectra observed in a fresh oil and in the same oil after use, showing new metals, are given. Moreover, an example is given of direct determination of TEL in gaoline. It appears that silver nitrate electrometric titration offers a speedy direct method of determining the dithiophosphate content of an oil. A group of di-thiophosphate industrial and synthetic dopes was examined. This enabled the authors to show a certain number of absorption bands characteristic of cations. These very intense bands enabled the detection of these dopes, in the concn normally used, by simple spectrum analysis. These investigations were extended to other types of dope: aliphatic esters, polyesters, phenol, etc. The limitations of the method are pointed out and some examples submitted. Of the gasoline dopes, the authors studied the alkylphenols with the carbon electrode, identifying each one by a so-called "extra-pole potential." (Authors' abstract.)

2052. Apparatus for differential thermal analysis of lubricating greases. D. B. Cox and J. F. McGlynn. *Analyt. Chem.*, 1957, **29**, 960–3.—An automatic apparatus specifically designed for differential thermal analysis of lub greasce is described. Experimental results reported include a re-examination of the phase change behaviour of pure lithium stearate and a new phase diagram for the model grease system lithium stearate–*n*-hexadecane. J. S.

2053. Potentiometric method for determination of carbonyl sulphide in petroleum gases. D. B. Bruss, G. E. A. Wyld, and E. D. Peters. *Analyt. Chem.*, 1957, **29**, 807–9.—Carbonyl sulphide in petroleum gases can be determined potentiometrically after absorption in alcoholic monoethanolamine soln by titrating it with standard silver nitrate soln. Mercaptans and hydrogen sulphide are first removed from the gas stream by absorption in alcoholic caustic soln. Concn as low as 2 mg/cu. m. may be conveniently determined. J. S.

2054. Spectrophotometric titration of olefins with electrically generated bromine. J. W. Miller and D. D. DeFord. *Analyt. Chem.*, 1957, **29**, 475–9.—A spectrophotometric titration method employing electrically generated bromine has been developed for the determination of olefins. Titrations are carried out in a 3 to 1 mixture of glacial acetic acid and methanol, with a small amount of potassium bromide and hydrochloric acid added.

Mercuric chloride must be used as a cat to permit direct titrations. Bromine numbers of 13 olefins of various structures were determined with a precision of better than 2% on samples ranging from 3 to 11 mg. Results obtained by this method are compared with values obtained by 2 standard procedures, both of which use bromine as the titrant. Advantages of the method are higher sensitivity, no electrical coupling between indicating and generating circuits, and determination of exact end points by extrapolation of linear portions of titration curves. J. S.

2055. Testing of a rotary concentric-tube distilling column. B. J. Mair, N. C. Krouskop, and S. D. Rossini. *Analyt. Chem.*, 1957, **29**, 1065–8.—A large lab concentric-tube dist column has been tested for throughput and separating power at speeds up to 4000 rev/min. For speeds up to 2400 rev/min, results confirm data previously obtained on a small column. Above 2400 rev/min the separating power was much lower than was expected. This is attributed to the generation of heat by friction in the vapour phase. J. S.

2056. Removal of elemental sulphur from hydrocarbon fractions. M. Blumer. *Analyt. Chem.*, 1957, **29**, 1039–41.—The presence of elemental sulphur from hydrocarbon mixtures obtained from sedimentary rocks interferes with the analyses of these mixtures by absorption and mass spectroscopy and leads to erroneous results in mol. wt. determinations. The sulphur can be completely removed by passing a *n*-pentane or benzene soln of the extracted sample through a column of activated copper powder. J. S.

2057. Determination of normal paraffins and normal olefins in petroleum distillates. K. H. Nelson, M. D. Grimes, and B. J. Heinrich. *Analyt. Chem.*, 1957, **29**, 1026–9.—A method for the determination of normal paraffins and normal olefins in 60°–400° F petroleum dist is based on the selective sorptic n of straight-chain cpds by a quantity of zeolite, Linde Molecular Sieve, Type 5A. A weighed quantity of zeolite is brought in contact with the petroleum dist and reweighed. After the unsorbed materials are removed by vacuum evaporation at 100° C, the zeolite is reweighed and the weight per cent of *n*-paraffins and *n*-olefins is calculated. The *n*-paraffins are determined by analysing an acid treated raffinate of the dist, and the *n*-olefins are obtained as the difference between the 2 analyses. A single determination, requiring about 15 minutes of operator time, can be completed in approx 1 hr. The accuracy and precision are of the order of $\pm 0{\cdot}5\%$. J. S.

2058. Determination of normal paraffins in olefin-free petroleum distillates by molecular sieve sorption and refractometry. R. D. Schwartz and D. J. Brasscaux. *Analyt. Chem.*, 1957, **29**, 1022–6.—Heptane, octane, nonane, and decane can be determined by a refractometric method in olefin-free petroleum dist. The sample is first distilled to yield fractions containing only one *n*-paraffin. These dist are then fractionated on chromatographic columns packed with Linde type 5A Molecular Sieve, which selectively removes the *n*-paraffins.

The refractive index of a portion of the *n*-paraffin-free eluate is measured. This value, the refractive index of the original dist, and the literature value for the refractive index of the pure *n*-paraffin assumed to be present in the dist are used to compute the *n*-paraffin content of the fraction. The results show an average precision of better than 1% of the *n*-paraffin content and an average error of less than 2% of the *n*-paraffin content. J. S.

2059. The separation of naphthalene and its hydrogenated products by vapour-phase chromatography. R. M. Soemantri and H. I. Waterman. *J. Inst. Petrol.*, 1957, **43** (399), 94–9.—Vapour-phase chromatography is used to analyse, quantitatively and qualitatively, mixtures of naphthalene with its hydrogenated products. The apparatus used, its calibration, and the interpretation of results are described, and the accuracy of the separation is found to be ±1·5%. 13 refs. C. B.

2060. Analysis of volatile organic compounds by means of vapour-phase chromatography. A. I. M. Keulemans and A. Kwantes. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 271–82.—Vapour-phase chromatography has recently found a place in the petroleum lab as an extremely valuable method of separating and identifying components of mixtures. With suitable modifications it may be adapted to the analytical separation of almost all types of volatile cpds. It is characterized by speed and satisfactory accuracy and does not require highly skilled personnel. The introduction of this procedure may be regarded as the greatest advance in the analysis of petroleum constituents and chemicals since the adoption of spectroscopic methods. The present paper gives an outline of the techniques of vapour-phase chromatography that have been developed. The flexibility of the method is illustrated by means of some practical examples taken from widely different regions of the petroleum field.
(Authors' abstract.)

2061. Use of silica gel and alumina in gas-adsorption chromatography. S. A. Greene and H. Pust. *Analyt. Chem.*, 1957, **29**, 1055.—The use of silica gel and alumina in gas adsorption chromatography is compared by analysing a complex gas mixture. These adsorbents are generally similar, although alumina is superior for light hydrocarbon analysis. Carbon dioxide can be eluted from silica gel at a low temp and can be separated from the near boiling hydrocarbons. J. S.

2062. A variable thickness cell for infra-red absorption spectrometry. H. Powell and N. Evans. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 371–81.—A variable thickness cell suitable for research and routine work is described. It is simple in design, leak-proof, has a small capacity (1·5 ml), and for cleaning purposes can be easily dismantled and reassembled without affecting the accuracy of setting. Certain modifications for special applications, *e.g.* the examination of waxes, are also outlined. The procedure for calibrating the cell is described and some typical curves correlating absorbence and absorbing thickness are given for some hydrocarbons. Tabulated data show that backlash is removed from the adjusting thread and that the repeatability of setting is consistent with the accuracy of measuring absorbence. The performance of the cell is adequate for all quantitative work even at the smaller thicknesses. Its use in double beam or "differential" spectrometry is illustrated, and the merits of this type of application are discussed with reference to the detection and determination of additives in lub oil blends. (Authors' abstract.)

2063. The determination of heavy oil composition by mass spectrometry. M. J. O'Neal *et al. Proc. Fourth World Petrol. Congr.*, 1955, **5**, 307–28.—Analytical methods have been developed for determining both mol.-wt. distributions and hydrocarbon-type compositions of heavy oils by means of mass spectrometry in combination with physical separation techniques. The descriptions of these methods and examples of their use indicate the wide applicability of mass spectrometry in the field of heavy hydrocarbon analysis, and at the same time show the great detail of structural information that can be obtained through present mass spectrometric techniques. Although mass spectrometry is still a comparatively new tool in the study of heavy oil composition, it has already become a most useful one. (Authors' abstract.)

2064. Some applications of electronic digital computers to fundamental research in the petroleum industry. M. P. Barnett. *J. Inst. Petrol.*, 1957, **43** (400), 108–11.—The author describes the uses of electronic digital computers in the interpretation of experimental data. Examples given include the evaluation of mass spectrometric data, the experimental investigation of mol structure, statistical thermodynamics, and combustion theory. 13 refs. C. B.

CRUDE OIL

2065. Analytical research on Italian crudes. G. Roberti *et al. Proc. Fourth World Petrol. Congr.*, 1955, **5**, 153–71.—Samples of crudes from the Cortemaggiore field and gasolines from Caviaga, Ripalta, and Bordolano fields have been analysed by the procedures generally used: dist, chromatography, dehydrogenation, and physical methods. In addition, the lighter samples have been examined with the i.r. spectrophotometer, and the medium fractions by the urea adduct method. Porphyrins and metals have been found in small quantities in the residues. While 2 different oil producing series in the Cortemaggiore field have been shown to give oils having the same chemical composition, significant differences have been found between the oils from different fields.
(Authors' abstract.)

2066. Relationship between sulphur content of crude oils and the sulphur content of conventional refinery products. W. L. Nelson, G. Thery Fombona, and L. J. Cordero. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 13–26.—The total sulphur content of straight-run products (240°–1000° F b.p.), cracked (thermal or cat) gasolines and cycle stocks, and petroleum coke is presented in the form of charts and tabulations, as a function of the sulphur contents of crude oils such as Venezuela, W. Texas, California, Heavy Mississippi, E. Texas, the Middle East, Wyoming, Mexico, etc. These charts may be used to estimate the sulphur content of straight-run and cracked products derived from representative crude oils if only the sulphur content of the crude oil be known. The ratios of % sulphur in product to % sulphur in crude oil (or feedstock) of different origin and of the same API gravity are discussed. Sour crude oils, those that contain appreciable hydrogen sulphide, are found in W. Texas, New Mexico, Kansas, Arkansas, the Middle East, and some fields in Wyoming. The high sulphur crude oils of Venezuela, California, and Mexico are never classified as sour. (Authors' abstract.)

2067. Waxy deposits and their combat. S. Rachfal. *Nafta (Krakow)*, 1956, **12**, 129–32.—Paraffin-base crudes are rich in saturateds, of which first to remain solid at room temp is hexadecane. They are more soluble in the lighter fractions

of the crude, and once these have been lost wax tends to be deposited on cooling. Polish crudes contain as much as 8·4% wax. Deposition depends also on the pipe surface, which acts as anchor points to very fine crystals of wax suspended in the crude and which in this particular state do not as yet impede the motion of the fluid in the pipe. Loss of gaseous phase lowers the solubility of paraffin wax in the crude. The removal of wax can be effected by mechanical or thermal means. Correct conditions of production may effectively prevent deposition of wax altogether. M. S.

GAS

2068. Natural gas hydrates. A. Czaplinski. *Nafta (Krakow)*, 1956, **12**, 155–8, 186–90.—Discovered at the end of last century by P. Villard, they were thought unimportant until 1934, when it was discovered that they are capable of blocking high-pressure natural gas pipes. The phase diagram describing their formation is similar to that of the H_2O–CO_2–CO_2 hydrate system. The latter is a solid which forms when there is a large quantity of compressed CO_2 and a small amount of moisture. Hydrocarbon hydrates form slowly, *i.e.* their constituents remain uncombined in a metastable state but are from such condition precipitated in a crystalline form by high speed of natural gas flow as well as other more familiar causes. In Poland they are most commonly formed in the spring when the soil temp is lowest. They form clathrate cpds of composition $(C_mH_n)_8.(H_2O)_{46}$, but often there are more H_2O mol than the above formula suggests. Hydrocarbons can also be easily replaced by H_2S or even H_2Se. Methane forms hydrates easiest, and hexane will not form one. Critical data and their graphs enable the engineer to predict pipe conditions. Whilst high pressure gas is most likely to emerge from the ground at high temp, hydrates will not form in pipe for a distance of 40–50 km. Soviet and American ways of dealing with the problem are described. They include lowering the pressures, raising temp, drying the gas, or introduction of a third constituent into the pipeline, such as certain N or O cpds. Amongst the most useful is methanol. The variation in the ease of formation of these hydrates from methane to hexane can be used for separation of these gases and the increase of vol of one at the expense of the other in a mixture. Another suggestion is that these gases can be induced to form crystalline cpds in presence of water, and so will be found easier to store than when dry. M. S.

ENGINE FUELS

2069. Production of high quality motor spirit. (In German.) E. Boye. *Chem. Z.*, 1957, **81**, 431–4.—A review of the methods available for increasing the octane rating of motor fuels. Methods described include Fluid Coking, Fluid Catalytic Cracking, Platforming, Houdriforming, Thermofor Catalytic Cracking and Reforming, etc. P. J. K.

2070. Important fuel developments. Anon. *Oil Eng.*, 1957, **24** (282), 366–8.—The article is in 3 parts. The first, the use of petrol in C.I. engines, reports work carried out at Henry Meadows Ltd, Wolverhampton. Performance curves are given for an engine set to give the same power output on gas oil or commercial grade petrol. Slight modifications were made to the injection equipment, to avoid the harmful effects of vaporization of the lighter fuels in the system. With petrol containing 2% lub oil, trouble was experienced with the fuel pump as a result of inadequate lubrication of the cams. Tests are in progress with paraffin and jet fuels to determine the optimum amount of lub oil required for satisfactory running. The second part, "High Speed and Omnivorous?" discusses the possibility of the development of a C.I. unit which would operate satisfactorily on oil fuels and the lighter fractions. The third part, fuel experiments with a coal basis, reports the use of Coalene fuels in passenger vehicle services in the Midlands and N. England. C. B.

GAS OIL AND FUEL OIL

2071. The constitution of petroleum fractions; structural group analysis of a Kuwait heavy gas oil. W. Carruthers *et al.* *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 123–45.—The present report describes the precise fractionation of a middle dist fraction from a Kuwait crude oil, and presents structural group analyses of the eight 5° C fractions boiling between 350° C and 390° C by the *n–d–M* method of van Nes and van Westen. A large number of stream samples drawn during the dist was analysed by this method, and the results are presented graphically to show the changes in group analysis with boiling range. In addition, a comparison was made between results obtained by the *n–d–M* method and those obtained by the *n–M* method of Fenske in the analysis of a series of narrow boiling range fractions from a Trinidad gas oil, and between the *n–d–M* method and the V_k–*n–d* method of Boelhouwer and Waterman in the analysis of the Kuwait fractions. A preliminary account is also given of the isolation of 3 tri-methylnaphthalenes from the Trinidad gas oil and of di- and tri-methyl substituted anthracene and phenanthrene derivatives from Kuwait gas oil. (Authors' abstract.)

2072. Hydrogenation improves fuel oil. Anon. *Fuel Oil & Oil Heat*, 1957, **16** (6), 74.—Some of the advantages of hydrogenation of fuel oil are tabulated and discussed. Some results observed were: API gravity is lighter, particularly on the cat-cracked oil and the blend. Visc is hardly affected. The fl. pt. is much better on straight cat variety and better on the straight run and blend. The odour is improved. The sulphur content is reduced, as is carbon residue. Hydrogenation also gives improved storage stability. D. K.

LUBRICANTS

2073. Lubricating oils and additives. (In German.) G. H. Thornley. *Erdöl u. Kohle*, 1956, **9** (9), 606–13.—A review of fuel additives for sp purposes and the impressive steps which have brought many changes in lubrication technology. A discussion follows. 14 refs. R. T.

2074. Investigations on the film resistance of lubricating oils in slide bearings in dependence on loading and rev/min. (In German.) E. Terres, G. Morlock, and K. H. Völker. *Erdöl u. Kohle*, 1956, **9** (9), 597–601.—Film strength is measured—in the apparatus described and illustrated—by the No. of shaft revs in which bearing surface unevenness causes film rupture and produces metallic surface contact. The moment of rupture is measured by means of an electric circuit. 38 lub oils of different origin and mark were tested—with and without additives—for visc, visc–temp behaviour, *d*, coking, etc. Basic oils of the same origin show an increase in lubricating effect with visc increase, also a similar effect on HP-oils containing additives. Such additives, whether they cause improvement or not in the visc–temp behaviour or oxidn resistance, or possess detergent properties, etc., affect the basic oil film strength adversely. Hydrodynamic theory indicates that, in the slide bearing, also in the mixed friction range, conditions are determined chiefly through the ranges in which hydrodynamic lubrication prevails. Division of the lub oil composition into paraffinic, aromatic, and naphthenic indicates that naphthenic oils exhibit better oil film properties. R. T.

2075. A critical study of the oxidation stability of insulating and lubricating oils. K. K. Rumpf and E. Jahn. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 119–28.—Based on a wide experimentation with different base oils for the production of insulating and turbine oils, the authors have developed a theory giving a general explanation for the oxidn behaviour of these special raffinates, which, as is known, varies considerably. Particular reference has been made to the following oxidn tests now being used in different European countries: British Method: BSS 148 : 1951 (Michie Test); Swiss Method: SEV 124 (Staeger Test); Austrian Method: OEVW 50/1951 (Four Period Tar Number by Dr Skala); German Method: DIN-Draft 51 554 (Baader–Copper Saponification No.); German Method: DIN 51 555 (Tar No. after Kissling Ageing Test). The discrepancy in the valuation of oils referring to these special methods is newly stressed. (Authors' abstract.)

2076. Temperature distribution in the journal bearing lubricant film. M. B. Purvis, W. R. Meyer, and T. C. Benton. *Trans. Amer. Soc. mech. Engrs*, 1957, **79** (2), 343–50.—Equations for the adiabatic temp distribution in the lub film are derived for infinite and short journal bearings. The equations are derived from Reynolds' Equation, by treating density and visc as functions of temp. It is shown that max temp in the film occurs at the point of minimum film thickness, and that the temp increases as long as the film remains continuous and as the lubricant flows through the bearing. Results of a numerical example are compared with experimental data. 7 refs, 3 pages of discussion. C. B.

2077. Aluminium and lithium greases—a technique for continuous production. J. N. W. Payne. *Petroleum, Lond.*, 1957, **20** (6), 221–4.—The operations in aluminium grease manufacture related are slurry preparation, heating, cooling, gelling, and working and de-aerating. The gelling tanks provide holding time, while the final stage subjects the grease to high shear under vacuum to break down the gel and de-aerate. Lithium grease slurry is prepared similarly, being also heated and cooled, after blending, in " Votator " units. Advantages of the continuous over batch kettle methods include better colour, reduced fire hazard, and labour economy. E. A. G. H.

2078. Lubricants for atomic power. Anon. *Petroleum, Lond.*, 1957, (7), 241–2.—The development of lubricant research for atomic power duty is recounted, constructional details of irradiation devices being described. Gamma radiation and neutron bombardment generally produce cpds of higher mol. wt. and increased visc, though stable oils have now been discovered. E. A. G. H.

2079. Lubricants for nuclear power stations. Anon. *Petrol. Times*, 19.7.57, **61** (1564), 426.—The Shell's radiation lab at Thornton Research Centre, Cheshire, is described. The lab, which employs a cobalt 60 source in the form of pellets, is equipped with an elaborate safety interlock system. G. A. C.

2080. Lubricant specifications. 5. Greases. E. G. Ellis. *Sci. Lubric.*, 1956, **8** (10), 14–24.—The development of lub grease specifications is outlined and the tendency to emphasize performance noted. Modern conventional tests are described and their significance indicated. British Railways specifications for carriages, motor vehicles, and locomotives, together with DTD 844 for E.P. low-temp greases, are set out and discussed. J. G. H.

2081. Lubricant specifications. 6. Cutting oils and refrigerator oils. E. G. Ellis. *Sci. Lubric.*, 1957, **9** (1), 12–17.—The importance of finding methods of test which will usefully measure physical properties of cutting fluids important in their application is emphasized. Ministry of Supply Spec C.S. 1662D, C.S. 2170A, and DEF 2301 are set out and discussed in some detail, together with B.S. 2626 for refrigerator oils. J. G. H.

BITUMEN, ASPHALT, AND TAR

2082. Homogeneous mixtures of coal tars and petroleum bitumens. H. J. Rang and E. J. Dickinson. *Chem. & Ind.*, 1957, 1097–8.—By mixing S.R. bitumen (40 pen) with coal tar or soft pitch at 160°–180° C and centrifuging (or settling and decanting) at 140° C, to remove pptd matter, a blend is obtained which remains homogeneous for at least 3 months at room temp. Behaviour of the blend on pressure oxidn (65° C, 72 hr, O_2, 300 p.s.i.) and its visc–temp characteristics indicate that it has a crit composition. Addition of aromatic oil helps to stabilize the system. W. A. M.

SPECIAL HYDROCARBON PRODUCTS

2083. Hydrocarbon propellants for aerosols. L. D. Goodhue and H. Franz. *Soap, N.Y.*, 1957, **33** (5), 103.—Physical data on the lower boiling hydrocarbons with vapour pressures in the range most suitable for aerosol propellants are presented. Propane, butane, and *iso*butane are the principal hydrocarbons considered, though some data are given on pentane and hexane. Charts show variation with temp of vapour pressure, density, surface tension, solubility of water in hydrocarbons, and flammability limits. The safe use of hydrocarbon propellants is also discussed. Typical formulations are included. D. K.

DERIVED CHEMICAL PRODUCTS

2084. Heterocyclic sulphur compounds. G. Roberti, R. Onesta, and A. Ferretti. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 147–52.—4 cyclic sulphides, namely 2-propyl-thia*cyclo*pentane, 2-butyl-thia*cyclo*pentane, 2-prim.-*iso*-butyl-thia*cyclo*pentane, and 2-(3-methyl)-butyl-thia*cyclo*pentane, have been synthesized and a few physical properties have been determined. The i.r. spectra are also given. The mercury chloride complexes have been prepared, and their m.p. is given. The rate of removal by mercurous nitrate in 1% soln has been determined. (Authors' abstract.)

MISCELLANEOUS PRODUCTS

2085. New insect repellent. I. H. Gilbert, H. K. Gouck, and C. N. Smith. *Soap, N.Y.*, 1957, **33** (5), 115; **33** (6), 95.—A review is given of the studies conducted during the last 2 years on diethyl toluamide alone and in mixtures with *o*-ethoxy-N, N-diethylbenzamide, ethyl hexanediol, and other chemicals. Repellents used as skin applications were tested in the lab against the yellow-fever mosquito and the malaria mosquito, and the stable fly; and in the field against salt-marsh mosquitoes, the sand fly, and the deer fly. Clothing inpregnants were tested in the lab against the yellow-fever mosquito and the oriental rat flea; and in the field against salt-marsh mosquitoes, the lone star tick, and the chigger. D. K.

2086. New developments in industrial detergents. J. Morrisroe. *Soap, N.Y.*, 1957, **33** (5), 47.—The developments considered are those in resources or raw materials, in product development or function, in process improvements, or in market use of products. Tables showing the market status of detergents in the U.S.A. are included. D. K.

CORROSION

2087. Anti-corrosion measures for large steel pipelines. R. Drake. *Pipes & Pipelines*, 1957, **1** (5), 15–18.—Materials and anti-corrosion measures for int and ext protection of pipes conveying sewage, gas, oil, or water are discussed with particular ref to valves, couplings, and joints. R. T.

2088. Chemical Research Laboratory Report for 1956. Anon. *Nature, Lond.*, 13.7.57, **4576** (180), 80.—A review is given of the report "Chemistry Research for 1956" published by HMSO for the DSIR. Among the subjects reported is the continuance of the investigation of corrosion problems of interest to the petroleum industry. Also of interest is the work on properties of pure organic cpds and the mechanism of organic reactions, and investigations with high polymers.

G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT

2089. A 15,000-b.h.p. engine on test. Anon. *Mot. Ship*, 1957, **38** (446), 147.—The results are given of trials on the 15,000-b.h.p. 12-cyl Hitachi-B-W diesel engine built for the 33,500-ton tanker *Yuyo Maru No. 5*. D. K.

2090. The Austin turbine motor car engine. Anon. *Oil Eng.*, 1957, **24** (282), 391–5.—A description of the Austin Sheerline fitted with 120-b.h.p. gas turbine engine is given. The engine consists of a 2-stage non-intercooled centrifugal compressor which is driven at 22,000 rev/min by a 3-stage axial turbine. Combustion takes place in a single chamber, air being pre-heated in plate-type, single-pass, cross-flow heat exchangers. The article is well illustrated and gives detailed descriptions of the engine and its aux equipment. Factors affecting both the choice of design and materials are discussed. C. B.

2091. The design and development of the turbocharged engine. Anon. *Mot. Ship*, 1957, **?3** (446), 164.—Short abstracts of some of the papers read at the International Congress of Combustion Engines held at Zurich in June 1957. D. K.

2092. Pre-flame reactions in diesel engines. Pt IV. The effect of compression ratio. F. H. Garner, F. Morton, J. B. Saunby, and G. H. Grigg. *J. Inst. Petrol.*, 1957, **43** (400), 124–30.—A CFR–ASTM diesel testing unit was used to determine the effect of varying C.R. on the formation of pre-flames. The effect of temp and pressure on the ignition lag is examined, and the physical and chemical aspects of the ignition delay are considered. Results are compared with those of other workers and with those previously reported by the authors. 22 refs. C. B.

SAFETY PRECAUTIONS

2093. Selling safety saves men and money. A. Gibbon. *Pipe Line Ind.*, 1957, **6** (2), 31–4.—In 1947 H. C. Price Co appointed a safety director to check the alarming rise in accident rate in all field operations. An organized safety plan—rules presented—reduced disabling injuries to pipeline crews from 157 in 1948—a frequency rate of 158·4 accidents/million man-hr worked—to 19 in 1955 for a frequency rate of only 7·1. An important phase is the distribution of a safety rule book to every employee. Incentive awards—chiefly savings bonds and pins—are presented to foremen with a clean accident record. Fewer accidents involving loss of time increase eff and decrease insurance premiums. R. T.

2094. Organizing for safety. T. T. MacLean. *Petroleum, Lond.*, 1957, **20** (6), 207–10.—The author discusses steps which should be taken to organize precautionary measures, such as periodical revisions of regulations, routine inspections, and investigations into the causes of accidents, while the functions of the safety officer are also considered. He proposes that workers be kept informed of developments which may influence the position, and management record and appreciate the relative statistics. E. A. G. H.

2095. What happens when crude oil burns. J. L. Risinger. *Pipe Line Ind.*, 1957, **6** (2), 39–42.—Effective fire prevention and fire fighting depend on knowledge of conditions for ignition of a substance and burning characteristics. For the latter a working knowledge of the physical properties listed is essential. Interesting fundamental ideas are presented. R. T.

2096. Fire precautions in the refinery. H. E. Bedford. *Petroleum, Lond.*, 1957, **20** (6), 205–6, 220.—Even to-day the problems of petrol storage and handling are receiving continuous attention to ensure that the latest improvements in equipment and techniques are utilized fully. Mention is made of specific points, such as corrosion dangers, pumping, and static electricity. Methods of fire-fighting outlined include fixed connexions to tanks, portable foam towers, and the use of dry chemical extinguishers. E. A. G. H.

2097. How to prevent crude oil tank fires. J. L. Risinger. *Petrol. Refin.*, 1957, **36** (2), 100.—This article summarizes the methods of crude oil fire prevention and gives many excellent pointers on the proper use of flame arresters, prevention of boilover and slopover, safeguards against lightning ignition, and the use of the right kind of tanks. J. R. T.

2098. Fire hazards of oil fuels for oil fuel heating apparatus. E. Southworth. *Instn Fire Engrs Quart.*, 1957, **17** (26), 135–140.—Petroleum products commonly used in the petroleum industry are classified by fl. pt. into 3 classes: A $<73°$ F, B $73°$–$150°$ F inclusive, C $>150°$ F. For the principal fuel oils fl. pt., visc Red. 1, min storage temp, and burning temp are given. Class A products are within the definition Petroleum Spirit and are subject to the provisions of the Petroleum (Regulation) Acts 1928 and 1936, *i.e.* motor aviation spirits, solvents, etc. Class B includes burning oils, *i.e.* paraffin, vaporizing oils (for tractors), white spirit (used in paint manufacture). Products with fl. pt. $>73°$ F—and subject to legislative control only in the City of London—are generally known as petroleum oils, as distinct from petroleum spirits with fl. pt. $<73°$ F. Regulations (1914) limit the quantity of material with fl. pt. $73°$–$150°$ F storable above ground. Class C products, diesel and fuel oils—fl. pt. $>150°$ F—do not come within Petroleum Regulation Acts 1928 and 1936, or LCC Regulation. Definitions and recommendations of the Fire Office's Committee cover storage and service tankage pipes, vents, fire valves, etc., for small plants only. The main hazard, spillage, must be prevented by bunds, pits, fire valves, etc. Information for installations >2000 tons storage of oil with fl. pt. $\not<150°$ F is provided by the Fire Offices' Committee and the IP Model Code of Safety Practice. For larger installations, grouping of tanks, a low surrounding bund, and a ring water main are important. For smaller domestic plants, etc., the Fire Offices' Committee refer to BS 799 : 1953. Requirements for a typical layout of a good fuel oil storage tank are listed. Location, size, and boiler burning equipment with automatic cut-off are discussed. R. T.

MISCELLANEOUS

2099. Planning of experiments. A. Vessereau. *Rev. Inst. franç. Pétrole*, 1957, **12**, 77–85.—The main principles of the application of statistics to the planning of experiments are discussed. W. A. M.

2100. Applications of statistical methods. R. Cavé. *Rev. Inst. franç. Pétrole*, 1957, **12**, 68–76.—An account is given of the statistical interpretation of expt results and application of the method to quality control. W. A. M.

2101. Computing facilities in Great Britain. J. H. Wilkinson. *J. Inst. Petrol.*, 1957, **43** (400), 101–7.—The author traces the development of electronic computers, from the first, ENIAC, which was constructed in Pennsylvania in 1946, to the modern high-speed machines. An account of the more important characteristics of computers is given, and a number of available machines are described. C. B.

2102. Sohio give analogue computers a trial. W. Jackson. *Oil Gas J.*, 8.7.57, **55** (27), 121.—Experience is noted by Standard Oil Co of Ohio with a medium-sized instrument used in the process engineering division. Types of computers, applications, systems, and results are discussed. G. A. C.

2103. Supplying the services. Anon. *Petroleum, Lond.*, 1957, **20** (7), 262–4.—The establishment and history of the chemical inspectorate in Great Britain is briefly described. Their research work on lub oils, greases, specialized lubricants and fuels, and high standard specifications have done much to aid the petroleum industry. E. A. G. H.

2104. Applications of radioactivity in petroleum technology. B. A. Fries, D. E. Hull, and S. B. Jones. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 329–50.—Measurements, tracers, and instruments employing the phenomenon of radioactivity have been adopted widely throughout the whole field of petroleum technology. In exploration for new oilfields, radioactivity surveys are now correlated with geological surveys. After a hole is drilled, the rock strata are identified with a nuclear log, using both natural radioactivity and induced nuclear radiations. In pipeline transportation, radioactive tracers are used to locate lost scrapers and to identify interfaces between consecutive stocks for accurate segregation. In refining, radiotracers are used in full-scale plant equipment to study characteristics, such as levels, vol, flow rates and patterns, and processes, such as dist, extraction, and blending. Radiotracers are used in lab research techniques for such widely varied investigations as oil recovery from porous rock, the mechanism of chemical reactions, and the lubricating quality of marketed products. Chemical analysis of process streams with radiation sources has become routine. Continuous motoring of plant streams and processes for automatic control now looms as a major development of the near future.

(Authors' abstract.)

2105. "The Finance People." What they do and how they do it. A. A. Buzzi. *API Quart.*, Spring 1957, 24–7.—Responsibilities and policies, structure and duties of finance are reviewed. The API Division of Finance and Accounting was established to make generally available the benefit of experience developed. Committees are at work on selected subjects. They are to serve the same purpose for API members that their counterparts in a company serve for other members of the company team. R. T.

2106. Calculate anchor bolt stress the easy way. A. A. Brown. *Pipe Line Ind.*, 1957, **6** (2), 47–52.—A graphical method is presented for quick and accurate analysis of anchor bolt stresses. It simplifies design of eccentrically loaded towers, scrubbers, and auxiliaries. R. T.

2107. Nuclear propulsion of merchant ships. S. L. Smith and J. E. Richards. *Mot. Ship*, 1957, **38** (446), 162.—The question of nuclear propulsion of merchant ships is considered. Aspects particularly discussed are: supply of nuclear fuel; nuclear fuel cycles and costs; type of reactor; engineering problems likely to be encountered—*i.e.* fuel elements, control, shielding, machinery arrangement and installation, safety. Prospects for nuclear-powered ships in Britain are also discussed, and reference is made to the feasibility study made by BSRA with the co-operation of tanker owners of the application of nuclear power to large tankers. D. K.

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In previous editions this book has become well known and respected by scientific and industrial research workers. Now the third edition has been published after undergoing extensive revision as a result of advances in theoretical statistical methods and of additional experience gained in industry. Apart from the new topics which have been introduced, the major change is a shift in emphasis towards the use of confidence limits, wherever this is possible, in place of significance tests. This is a very welcome innovation to a book of this nature, since confidence limits contain all the information given by significance tests and avoid one of the disadvantages of the latter. The habitual use of significance tests tends to make many experimenters concentrate on controlling just one of the two fundamental types of error which may be committed in research, that of finding a difference where none exists. The calculation of confidence limits, however, makes the experimenter directly aware of the sensitivity of his experiment, and so ensures that he does not ignore the second kind of error, that of failing to detect a difference which does exist and is large enough to be of practical importance. Since many of the economic rewards of research arise from the discovery of differences, the importance of controlling the risk of making this second kind of error cannot be overemphasized.

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This book is recommended reading for everyone who is in any way concerned with the results of experiments, but its real place is as a work-book on the laboratory bench. Every laboratory should have its copy of the third edition, even if it already has an earlier one. B. A. M. T.

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MISCELLANEOUS

2099. Planning of experiments. A. Vessereau. *Rev. Inst. franç. Pétrole*, 1957, **12**, 77–85.—The main principles of the application of statistics to the planning of experiments are discussed. W. A. M.

2100. Applications of statistical methods. R. Cavé. *Rev. Inst. franç. Pétrole*, 1957, **12**, 68–76.—An account is given of the statistical interpretation of expt results and application of the method to quality control. W. A. M.

2101. Computing facilities in Great Britain. J. H. Wilkinson. *J. Inst. Petrol.*, 1957, **43** (400), 101–7.—The author traces the development of electronic computers, from the first, ENIAC, which was constructed in Pennsylvania in 1946, to the modern high-speed machines. An account of the more important characteristics of computers is given, and a number of available machines are described. C. B.

2102. Sohio give analogue computers a trial. W. Jackson. *Oil Gas J.*, 8.7.57, **55** (27), 121.—Experience is noted by Standard Oil Co of Ohio with a medium-sized instrument used in the process engineering division. Types of computers, applications, systems, and results are discussed. G. A. C.

2103. Supplying the services. Anon. *Petroleum, Lond.*, 1957, **20** (7), 262–4.—The establishment and history of the chemical inspectorate in Great Britain is briefly described. Their research work on lub oils, greases, specialized lubricants and fuels, and high standard specifications have done much to aid the petroleum industry. E. A. G. H.

2104. Applications of radioactivity in petroleum technology. B. A. Fries, D. E. Hull, and S. B. Jones. *Proc. Fourth World Petrol. Congr.*, 1955, **5**, 329–50.—Measurements, tracers, and instruments employing the phenomenon of radioactivity have been adopted widely throughout the whole field of petroleum technology. In exploration for new oilfields, radioactivity surveys are now correlated with geological surveys. After a hole is drilled, the rock strata are identified with a nuclear log, using both natural radioactivity and induced nuclear radiations. In pipeline transportation, radioactive tracers are used to locate lost scrapers and to identify interfaces between consecutive stocks for accurate segregation. In refining, radiotracers are used in full-scale plant equipment to study characteristics, such as levels, vol, flow rates and patterns, and processes, such as dist, extraction, and blending. Radiotracers are used in lab research techniques for such widely varied investigations as oil recovery from porous rock, the mechanism of chemical reactions, and the lubricating quality of marketed products. Chemical analysis of process streams with radiation sources has become routine. Continuous motoring of plant streams and processes for automatic control now looms as a major development of the near future.

(Authors' abstract.)

2105. "The Finance People." What they do and how they do it. A. A. Buzzi. *API Quart.*, Spring 1957, 24–7.—Responsibilities and policies, structure and duties of finance are reviewed. The API Division of Finance and Accounting was established to make generally available the benefit of experience developed. Committees are at work on selected subjects. They are to serve the same purpose for API members that their counterparts in a company serve for other members of the company team. R. T.

2106. Calculate anchor bolt stress the easy way. A. A. Brown. *Pipe Line Ind.*, 1957, **6** (2), 47–52.—A graphical method is presented for quick and accurate analysis of anchor bolt stresses. It simplifies design of eccentrically loaded towers, scrubbers, and auxiliaries. R. T.

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recipes for making thousands of products in many fields of industry." It is the tenth such volume and, except for the introduction of 40 pages, all formulæ are new. Various types of lubricant are included, from bullet lubricant to wire-drawing, as also are such materials as emulsions, asphalt, oil-well cement, styrene lacquer, to cite but a few. Where applicable, patent numbers are given, and a list of suppliers of chemicals in the U.S.A. is appended.

1957 SAE Handbook. New York, Society of Automotive Engineers, 1957. Pp. 1176.

Details are given of all up-to-date SAE standards and recommended practice which cover ferrous and non-ferrous metals, non-metallic materials (including lubricants), threads and fasteners, electrical equipment, power plant components, and vehicle parts. There are no changes in the classifications of crankcase oils, etc.

ADDITIONS TO THE LIBRARY

Entries are in subject order arranged according to the Uren "Classification for Petroleum Bibliography," the number preceding each entry indicating the classification and corresponding to that used in the "Library Catalogue" published by the Institute. Books marked with an asterisk cannot be borrowed from the Library.

020 Society of Automotive Engineers. 1957 SAE handbook. New York, SAE, 1957. 1176 p.

020 World Petroleum Congress. Fourth World Petroleum Congress, Rome, June 6–15th 1955, proceedings. Section V. Composition of petroleum. Rome, Carlo Colombo, (1956). 493 p.

030 Alberta Research Council. Thirty-seventh annual report 1956. Edmonton, Research Council, 1957. 48 p. (Report no. 76.)

080 Arabian American Oil Company. 1956 report of operations to the Saudi Arab Government. Dhahran, Aramco, 1957. 47 p.

*080 Association of British Chemical Manufacturers. British chemicals and their manufacturers: the directory of the Association of British Chemical Manufacturers. London, ABCM, 9157. 200 p.

*080 Council of British Manufacturers of Petroleum Equipment. British petroleum equipment, 1957/58 edition. London, CBMPE, 1957. 787 p.

080 Shell-Mex and B.P. Ltd. 1956 in perspective: a review of the activities of Shell-Mex and B.P. Ltd, Scottish Oils and Shell-Mex Ltd, Irish Shell Ltd. London, Shell-Mex and B.P., 1957. 26 p. Supplement to Shell–B.P. News.

090 British Standards Institution. British Standard methods for the determination of the viscosity of liquids in C.G.S. units. London, BSI, 1957. 62 p. (BS 188 : 1957.)

090 British Standards Institution. Dimensions of screwed sealing plugs (low pressure) with unified screw threads. London, BSI, 1957. 12 p. (BS 2859 : 1957.)

090 British Standards Institution. Electric lifts. Part 1. General requirements. London, BSI, 1957. 52 p. (BS 2655 : Part 1 : 1957.)

090 Davies, O. L. *ed.* Statistical methods in research and production with special reference to the chemical industry. 3rd ed. London, Oliver and Boyd for ICI, 1957. 406 p.

090 Oil Companies Materials Committee. Plastic telecommunication cables. London, Oil Companies Materials Secretariat, 1957. 8 p. (Specification no. ELEC. 5.)

110 Illinois State Geological Survey. Petroleum industry in Illinois in 1955. Part 1. Oil and gas developments, by A. H. Bell and V. Kline. Part 2. Waterflood operations, by P. A. Witherspoon and D. A. Pierre. Urbana, Ill., State Geological Survey, 1957. 195 p. (Illinois State Geological Survey bulletin 81.)

115 Trinidad and Tobago. Petroleum Department. Annual administration report for the year 1955. Trinidad, Petroleum Dept., 1957. 35 p.

220 Co-ordinating Research Council. Significance of the cetane number of diesel fuels condensed version. New York, CRC, 1956. 2 p. (CRC 291A.)

260 Co-ordinating Research Council. Development and field testing of global greases, 1948–1954 (final report on evaluation of all-purpose greases in terms of equipment performance). New York, CRC, 1957. 33 p. (CRC 307.)

260 Co-ordinating Research Council. Development of test techniques for determining load carrying, wear, and extreme-pressure characteristics of gear lubricants in axles, under conditions of high-speed low-torque operation, followed by low-speed high-torgue operation. New York, CRC, 1957. 22 p. (CRC 308.)

270 Deutscher Normenausschuss. DIN Normblatt-Verzeichnis 1956. Berlin, Deutscher Normenausschuss, 1956. 388 p.

530 United States. Bureau of Mines. Laboratory evaluation of water additives for petroleum displacement, by H. N. Dunning and R. T. Johansen. Washington, D.C., U.S. Dept. Interior, 1957. 27 p. (Report of investigations 5352.)

610 Organisation for European Co-operation. Trends in economic sectors: maritime transport. Paris, OEEC, 1957. 69 p.

610 Sun Oil Company. Analysis of world tank ship fleet December 31, 1956. Philadelphia, Pa., Sun Oil Co., 1957. 40 p.

710 United States. Bureau of Mines. Natural-gasoline and cycling plants in the United States, January 1, 1956, by I. F. Avery and L. V. Harvey. Washington, D.C., U.S. Dept. Interior, 1957. 11 p. (Information circular 7790.)

730 Cremer, H. W. *and* Davies, T. *eds.* Chemical engineering practice. Vol. 3. Solid systems. London, Butterworths, 1957. 552 p.

750 Bennett, H. *ed.* The chemical formulary: a collection of valuable, timely, practical, commercial formulæ and recipes for making thousands of products in many fields of industry. Vol. 10. New York, Chemical Publishing Co., 1957. 392 p.

750 Claxton, G. Working data for the benzole industry. London, National Benzole and Allied Products Association, 1957. 73 p.

800 United States. Bureau of Mines. National motor gasoline survey. Winter 1956–57, by O. C. Blade. Washington, D.C., U.S. Dept. Interior. 1957. 32 p. (Information circular 7796.)

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

2113. Micro-palæontological studies: use of acetic acid for disintegrating hard rocks. M. Bourdon. *Rev. Inst. franç. Pétrole*, 1957, **12** (1), 14–15.—It has been found possible to get a good recovery of micro-fossils from limestones which are clayey or slightly dolomitic or sandy by treatment with acetic acid. 6–8 cc of sample is dried below 100° C, broken up, and placed in a wide-mouthed 60-cc flask. 5 g of anhydrous $CuSO_4$ is added before pouring in pure anhydrous crystalline acetic acid to fill ⅔ of the flask. A stopper is fitted to prevent ingress of moisture without complete sealing. Used acid is decanted and more $CuSO_4$ added if needed to ensure the continued presence of anhydrous salt, while the temp is kept above 16° C. When attack ceases, pour off excess acid, and transfer the sludge in small portions for neutralization in a beaker of pure 28° Bé ammonia, taking precautions because of the violent reaction. Dilute and wash away the mud on a sieve to recover the fossils. The acid treatment may require from one day to several months. G. D. H.

A A

2114. Bois d'Arc pay spurs limestone exploration. Pt 1. E. Barrett and E. F. Culp. *Oil Gas J.*, 3.6.57, **55** (22), 169.—Oil and gas accumulations in the Bois d'Arc member of the Hunton formation in Central Oklahoma are described, as an aid to further exploration and development of fields producing from this pay. There is currently an intensive search for Hunton production in this area, the 2 largest fields, both stratigraphical traps, being W. Edmond and Short Junction. The Bois d'Arc occurs at the top of the Hunton, and is a fossiliferous, partly oolitic limestone. It is overlain unconformably by the L. Mississippian Woodford shale and has been subjected to 2 major periods of weathering, with development of secondary porosity and permeability. Studies have been carried out to determine areas which were most extensively weathered, leached, and fractured and also the zones whose lithology favoured the development of good secondary porosity. C. A. F.

2115. Another salt barrier falls. F. J. Gardner. *Oil Gas J.*, 3.6.57, **55** (22), 167.—It has been predicted that as many new fields will be found on salt domes over the next 50 years as have been found since Spindletop was discovered in 1901. In spite of the considerable amount of data that has accumulated on salt domes, there is much that is unknown about their origin, nature, and effects.

Ca 100 salt domes exist in Texas, Louisiana, and Mississippi which have been inadequately explored, and this has been emphasized by the recent discovery of the first salt dome field in the N. Louisiana salt basin, where 1 Hudson, on Minden Dome, Webster Parish, was completed for gas and condensate production in the L. Cretaceous Paluxy. The well is on the E. flank of a piercement dome. C. A. F.

2116. Two strikes breathe hope into Powder River basin. F. J. Gardner. *Oil Gas J.*, 10.6.57, **55** (23), 171.—The Powder River basin of Wyoming is the second largest basin in the U.S.A. and, although there have been producing fields in the basin since 1889, discoveries have been confined to the margins, mostly on the SW. and SE. edges, and there has been little interest in the deep possibilities of the basin. 2 recent deep wells, however, have been successful: B-6 Burrows on the E. side of the basin has been completed for 672 b.d. of 32° oil from the Pennsylvanian Minnelusa at *ca* 7700 ft; and 1 Ferguson Government in the central part of the basin has reported oil on test of Cretaceous Parkman sand at *ca* 7000 ft. C. A. F.

2117. Honduras search near. Anon. *Oil Gas J.*, 3.6.57, **55** (22), 82.—Aerial photography and surface exploration is to be carried out in a concession covering 11,000,000 acres in Honduras. A 400-ft well is also to be drilled this year down-dip from an oil seep in Santa Barbara Province in the W. part of the state. A sedimentary basin with Mesozoic marine beds is believed to be present in this area, but these tend to be masked by red beds and tuffs.

No commercial production has yet been obtained in the country, but oil seeps and many favourable structures have been known for many years. A dry hole was drilled in 1954 near the Laguna de Caratasca on the N. coast *ca* 80 miles from the Nicaraguan border. C. A. F.

2118. Present knowledge of the Lacq structure. M. Schoeffler. *Bull. Ass. franç. Tech. Pétrole*, July 1957, 267–74.—Below some 500 m of marly Tertiary the dominantly limestone and dolomite series of the Upper Cretaceous occurs. Beneath are marly, calcareous, and dolomitic Albo-Aptian beds overlying the Neocomian and gas-bearing Upper Jurassic. The Lacq structure disappears westwards beneath an overthrust. Thickness data on the Upper Cretaceous, Albo-Aptian, and Ste Suzanne marls show features which can be broadly linked with the direction of elongation of the Neocomian dome, but the Albo-Aptian shows some westward thickening, while the Upper Cretaceous has some eastward thickening; the Ste Suzanne marls thin N. and S. of the crest, but appear to thicken eastwards and westwards. G. D. H.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

2119. Mapping of salt flanks by seismic methods. (In German.) G. A. Schulze and H. J. Trappe. *Erdöl u. Kohle*, 1956, **9**, 580–3.—Fixing the Rethem salt plug limits is described with a supporting plan. Bed velocities in the country rock and in the salt are determined from fixed points by deep seismic measurements in wells on the dome flank. Geological conditions are clarified by a refraction profile. For determining the salt flank 4 points are shot, and the seismic waves registered with a well seismograph. The dependence of the flank position on the salt velocity is shown. Explanatory diagrams are presented. R. T.

2120. Continuous velocity measurement in borings. (In German.) R. G. van Nostrand. *Erdöl u. Kohle*, 1956, **9**, 583–7.—With the instrument described and illustrated a brief vibration propagated in the drilling mud is transmitted to the well wall along which it diffuses and returns to the receiver. In principle this is a refraction measurement. Thereby the measured t is the shortest travel time between transmitter and receiver. The travel time in the drilling mud Δt is negligible. The instrumentation is situated above ground. From theoretical considerations and lab experiments it is judged possible—at least in certain rock types—to recognize oil and gas bearing beds by using velocity diagrams. 8 refs. R. T.

2121. Weight dropping, a practical seismic tool on land or water. A. Waldie. *World Petrol.*, 1957, **28** (3), 56.—The weight dropping technique for providing seismic energy has proved very useful in prospecting in some difficult areas, and it has produced vertical energy records at a lower cost than conventional methods. A 6000-lb weight is dropped from a height of 9 ft to the ground, and this creates an impact equivalent to *ca* $\frac{1}{2}$ oz of 60% gelatin dynamite, with elastic energy equivalent to *ca* $2\frac{1}{2}$ lb.

The mechanism for controlling the weight is versatile, and can be mounted on most suitable vehicles. A number of field procedures can be used which are briefly described, with diagrams showing methods of coverage and drop-pattern. Tape-recording equipment is used in the field, and the data is processed to provide composite records. A land cable with built-in miniature geophones has been introduced which will permit mechanized planting at rates up to 5 m.p.h. C. A. F.

2122. Attempt at horizon-analysis of Carpathian foothill Miocene by spectrographic methods. Z. Biernat. *Nafta (Krakow)*, 1956, **12**, 203–5.—Instead of the commonly used palæontological methods, spectrographic analysis uses tracer elements such as Ca, Ba, Sr, Mn, Al, Si, V, Cr, Ni, Ti, Co, Mg, Cu, and Fe, also occasionally Mo and In. Only Ca, Ba, Sr, Mn, Ni, and V have been chosen for this work. Results relating to the particular formation are sufficiently accurate to justify the use of this method. M. S.

DRILLING

2123. Gulf offshore activity booming. J. W. Calvert. *World Petrol.*, 1957, **28** (1), 48.—Drilling developments offshore in the Gulf of Mexico are briefly described. The first offshore discovery was made in 1947, and during the last 10 years drilling operations have been carried out on a large and expensive scale; some $2 billion have been spent over this

period, resulting in 600 producing wells. There has been some standardization of drilling equipment and techniques for offshore work, and the various types of drilling platform and barges now in use are noted. Some of the legal problems in the area are also outlined. C. A. F.

2124. Water still poses tough problem in drilling with air. A. S. Murray and S. P. MacKay. *Oil Gas J.*, 10.6.57, **55** (23), 105.—Air-drilling tests carried out in W. Canada using a range of drilling media, from air to aerated water, have shown that a water influx of 100 brl/hr was the max rate for economic air drilling. With foam injection, drilling could be maintained with a water influx of 500 brl/hr. It was found that penetration rate when air-lifting 500 brl/hr was no greater than the rate when drilling with mud.

It is concluded that air drilling has an application in W. Canada and that competent formation producing water at high influx rates can be drilled with the simultaneous injection of water and foam. Lost circulation may be overcome by using air, but it has not been possible to air drill medium to soft shales under wet conditions. 2 refs. C. A. F.

2125. Method of protecting cements against the harmful effects of mud contamination. H. J. Beach and W. C. Goins. *J. Petrol. Tech.*, 1957, **9** (5), AIMME Tech. Paper No. 4583, 148–52.—Mud contamination is a major cause of oil-well cement failures. Many mud additives, notably organic substances, have been shown in the lab to have marked effects on the properties of cements. In one study the addition of activated charcoal gave successful sets after conventional slurries had failed. Mud also causes dilution of cement.

Removal of the set-retarding properties of organic contaminants (except calcium ligno-sulphonate) was demonstrated in the lab by the use of a decontaminant consisting of 3 parts paraformaldehyde with 2 parts of sodium chromate tetrahydrate. This was effective over the temp range 80°–200° F. A suitable amount was 1 lb/sack of cement (API class A). In field tests the cement was mixed with fresh water to avoid side reactions. In a number of open-hole plugs the cement was hard after the top few feet had been drilled off. Of 40 plugs set 95% were successful with the use of the decontaminant. This technique may not be needed in primary casing jobs, but may be of use in cementing liners because the cement slurry volume is usually just enough to fill the annulus, and extensive flushing does not occur. It could also help in squeeze jobs.

Dry mixing of the decontaminant with the cement is satisfactory if the cement is used within 3 days. Otherwise an aq suspension of the decontaminant is added to the cement truck tank while it is being filled with water. G. D. H.

2126. Core-hole barges—vintage 1957. D. H. Stormont. *Oil Gas J.*, 3.6.57, **55** (22), 86.—A floating drilling barge is described which is used for stratigraphic drilling in the coastal waters of California. It is a converted L.S.M. (landing ship medium) and has drilled to 6000 ft, but potential max depth is greater. In floating-barge drilling the well-head equipment is set on the ocean bottom and controls are by means of hydraulic lines operated from the barge. Details of drilling methods are given, with photographs; during drilling a packer in the submarine head seals the drill string and prevents ocean water entering the hole. A double control gate also provides a secondary seal for packing off round the drill string.

A logging unit has been installed and also a closed-circuit television system, which permits the sea floor drilling controls to be viewed. The camera is enclosed in a waterproof housing and can be lowered on guide lines. C. A. F.

2127. Electrodrill—a way to improve technical and economic index of oil and gas drilling. N. E. Archangielsky and J. Wojcik. *Nafta (Krakow)*, 1956, **12**, 247–8.—An electrodrill is being tested in the U.S.S.R. It is 250 mm in dia, 11·8 m long, and consists of an electric motor sealed with transformer oil from water or mud and a driving shaft. Lubricator is guarded by a loaded spring which also keeps the pressure inside roughly 0·2–2·5 atm above mud pressure. Electric power is supplied from the surface at 1100 V and 162 amp producing a rated 150 kW with a momentum of 275 kg × m. In certain circumstances the current can rise to 461 amp and angular momentum of the shaft to 475 kg × m. The motor revolves at 530 rev/min. 2 other motors with power of 180 and 100 kW have also been produced for experimental work. The advantage of an electrodrill is that the power is independent of the quantity of mud, and lower mud pressure is required, but the results are slightly worse than those obtained with a turbodrill. M. S.

2128. Coring drill for obtaining uniform samples of formation from wells. S. M. Bolshakov and R. Piatkiewicz. *Nafta (Krakow)*, 1956, **12**, 246–7.—Bolshakov designed a sampler which is here described with a diagram. It is claimed that water content of the sample is preserved. M. S.

2129. Microbit dynamic filtration studies. V. Horner, M. M. White, C. D. Cochran, and F. H. Deily. *J. Petrol. Tech.*, 1957, **9** (6), AIMME Tech. Paper No 4[illegible] The apparatus had a rotating bit working [illegible] sample and a means of mud circulation. A liq-saturated rock sample was drilled, and the amount of connate water displaced was measured. The samples were 4 inches long and 2 inches dia, being sealed at the periphery. The bit was 1¼ inches dia. 3 inches of hole were drilled. It appears that the amount of fluid displaced decreases as penetration rate increases. Using an oil-base mud the total filtration was not very sensitive to pressure drop; it was affected by the visc of the connate fluid.

Various muds were tested under standard conditions based on the preliminary work. Little if any trend could be established between fluid properties (visc, yield value) and dynamic filtration. There was no apparent relationship between API fluid loss and dynamic filtration. G. D. H.

2130. Analysis of construction of home-produced drilling bits. H. Slupczynski. *Bull. Polish Inst. Petrol.*, 1956, **6**, 7 (suppl. *Nafta (Krakow)*, 1956, **12**).—A report on work carried out at the Mechanical Dept of the Polish IP. General improvements have been suggested in the way of working the metal, and these were passed to the works as the investigations were proceeding. M. S.

2131. Steel for drilling and drilling bits. M. Dubowicki and A. Kalinski. *Nafta (Krakow)*, 1956, **12**, 205–12.—Factory for drilling equipment and machinery still produces enough percussion bits to justify this paper, which deals with the steels suitable for this purpose. Methods of manufacture and temp of casting are given. M. S.

2132. Water as drilling fluid. D. M. Mironov *et al.* *Nafta (Krakow)*, 1956, **12**, 248–9.—Excellent results were obtained in Baskiria in 1952 using a turbo-drill and water in place of mud, and since then 880 m/rig/month have been reached in 1954. Theoretically it should be possible to reach 1500 m/rig/month in this way, which is also much cheaper and less corrosive. However, just before the oil-bearing formation is reached a change to ordinary mud is advised. M. S.

2133. Emulsions for use as non-plugging perforating fluids. G. G. Priest and B. E. Morgan. *J. Petrol. Tech.*, 1957, **9** (6), AIMME Tech. Paper No. 4596, 177–82.—Plugging of perforations by compaction of solids or other means harms the productive capacity of a well. Some benefits in this respect may be obtained from having non-plugging fluids in the well at the time of perforating. In order to use minimum vol such

fluids should be spotted at the level to be perforated, calling for a fluid slightly denser than the circulating fluid. Lab tests have been made with emulsions of NaCl or $CaCl_2$ soln and diesel oil or other organic liq stabilized by one or other of various substances. Oil-in-water and water-in-oil emulsions were used. Tests were made of fluid loss, density, thermal stability, and corrosiveness. The emulsions ranged 7·5–12·5 lb/gal in density, and gave low filtration values up to 200° F. Test targets were perforated at 180° F and 2000 p.s.i., with a pressure differential of 500 p.s.i. for several hr before simulating " bringing in " the well. The perforations were found to be free of debris. Filtration rates were 20–120 ml in 24 hr, and after this period back flow could be initiated by pressure drops less than 3 p.s.i. 4 field tests are described, and these offered some evidence of the beneficial effects of spotting emulsions when perforating. Precautions must be taken to prevent the emulsion giving a thickened mass with mud.

G. D. H.

PRODUCTION

2134. Factors affecting well productivity. I. Drilling fluid filtration. E. E. Glenn, M. L. Slusser, and J. L. Huitt. *J. Petrol. Tech.*, 1957, **9** (5), AIMME Tech. Paper No. 4584, 126–31.—Careful study of filter-cake test data has shown that in the standard technique using filter paper, and also when a porous solid forms the filter, there is an initial surge loss of short duration, and in this period bridging begins. A period of non-uniform cake thickness follows (the phenomenon is affected by the mesh of the screen supporting the paper) and then there is the phase of constant pressure filtration. Filter cake forms upstream from the particle bridges as filtration continues, and is to some extent internal as well as on the exposed surface of the porous solid. Even short exposure of porous solids to mud showed some loss of permeability, and this was not recovered after considerable back-flushing. The surge loss was found to increase with sample permeability and with the applied pressure difference. $\frac{\theta}{V} = mV + n$ (θ = time; V = volume of filtrate; m depends on the filter cake; n depends on the septum) was of use in evaluating the filtration characteristics of drilling muds. G. D. H.

2135. Mechanics of hydraulic fracturing. M. K. Hubbert and D. G. Willis. *J. Petrol. Tech.*, 1957, **9** (6), AIMME Tech. Paper No. 4597, 153–68.—Theoretical considerations concerning the fracturing of rocks by means of pressure applied to fluids in a bore-hole indicate that whether the fluid is penetrating or non-penetrating the resultant fractures should be approx perpendicular to the axis of least stress. Normally underground the 3 principal stresses are unequal; in tectonically relaxed areas marked by normal faults the least stress will be horizontal, and hence vertical fractures will result; in areas of active tectonic compression the least stress will be vertical, and hence fracturing by fluid pressure will give horizontal breaks. In the former case fractures will be formed at pressures less than the overburden pressure; in the latter case pressures equal to or greater than the overburden pressure will be needed to form fractures.

Lab tests using gelatine as the rock and dilute plaster of Paris as the injection fluid agreed with the theoretical conclusions. Field experience also lends support.

The direction of the fractures is important in production. To be most effective secondary recovery plans should take note of possible fracture directions. If vertical fractures break across permeability barriers they will have good or bad effects, depending on the formation fluids thus put in communication. However, fractures cutting across fluid contacts will tend to reduce gas or water coning into the oil section at a given rate of production. G. D. H.

2136. Application of radioactive isotopes on sand for hydraulic fracturing in Krasnodar oilfields. J. W. Tiesluk and S. Kosieradzki. *Nafta (Krakow)*, 1956, **12**, 249–51.—In the first attempt to locate cracks radioactive waters were used, but pictures obtained were far from clear. Later " grain-shaped " isotopes were made by deposition of cobalt salts with half-life 4·95 ± 0·04 hr on sand of 0·6–0·8 mm dia. This sand, when impregnated and dried, was mixed with bakelite and heat-treated so as to cover the granules with a waterproof coat. When the activity of the sand settled the natural radioactivity of the formation was evaluated first and after the radioactive sand had been introduced mixed with ordinary sand in sufficient quantity to leave a record on logging strip. The experiments were very useful. M. S.

2137. Electronic computers' magic talents speed improved production technology. W. A. Bruce. *Oil Gas J.*, 3.6.57, **55** (22), 110.—Recent developments in analogue and digital computers are proving very useful in reservoir analysis. Reservoir behaviour can be described in terms of differential equations, but the use of standard mathematical methods can involve simplifying assumptions about boundary conditions which have been unrealistic. High-speed computers are, however, now enabling more realistic boundary conditions to be used in calculations. The applications of these computers to some of the common production and geophysical problems are briefly outlined. 2 refs. C. A. F.

2138. Development of a generalized Darcy equation. M. R. Tek. *J. Petrol. Tech.*, 1957, **9** (6), 45–7.—Houpeurt has suggested that deviations from Darcy's law may be explained by kinetic energy variations and jetting effects without calling for turbulent flow. For a series of capillary passages in the form of truncated cones an approx relationship may be obtained:

$$\frac{\Delta P}{\Delta r} = \frac{\mu}{k} V\left[1 + \frac{c(m^4 - 1)\rho V}{16n''m\mu\omega}\right]$$

$\frac{\Delta P}{\Delta r}$ = overall pressure gradient; V = average velocity; k = permeability; c = radius of capillary constriction; m = ratio of radii for capillary enlargement and constriction; n'' = ratio of length of semi-pore to radius of constriction; ω = porosity; ρ = density; μ = visc. Setting $\frac{c(m^4 - 1)}{16n''m} = \alpha d$, where d = average grain dia and α = lithology factor, reduces the apparent complexity. The Fanning equation gives the dimensionless friction factor as $f = \frac{(-\Delta P)}{\rho} \cdot \frac{d}{2L} \cdot \frac{1}{2V^2}$ and the Reynolds No. is $R_e = \frac{\rho V d}{\mu}$, which with the modified first relationship yield

$$f = \frac{d^2}{2kR_e}\left[1 + \frac{\alpha}{\omega} R_e\right]$$

This is the dimensionless generalized Darcy equation.

Plots of f against R_e show comparisons of experimental data with the Darcy equation and with the generalized form derived. As R_e increases there is increasing deviation from the former, but fair agreement with the latter. At a given value of R_e, the ratio of the predicted pressure gradients for the generalized and ordinary Darcy equations is $1 + \frac{\alpha}{\omega} R_e$. For reservoirs giving oil $\frac{\alpha}{\omega} R_e$ is usually very small and can be be neglected in most cases. G. D. H.

2139. Applicability of electric logging devices. H. Guyod. *World Oil*, 1957, **145** (1), 107.—In estimating porosity and water saturation from electric logs, true resistivity (R_T) must be determined as accurately as possible. Under certain conditions some devices give a close approximation to R_T,

but generally the apparent resistivity (R_a) must be corrected. The response of various devices for invaded and non-invaded beds, for varying values of R_a/R_T, bed thickness (e), and varying values of R_i/R_T (R_i = resistivity of invaded zone) and dia of invaded zones, is shown in a series of departure curves.

R_a as measured by any logging device is an average resistivity for a certain thickness of formation. This thickness is always greater than the spacing, even with focusing devices, so that the influence of surrounding formations is important. Criteria for choosing a logging tool are discussed and 3 conclusions are given: (1) generally, no logging device can be predicted to give a small departure under usual conditions; (2) the methods of determining R_T at present depend on running at least 3 devices and/or spacings, and these are applicable except for thin beds (when the normal and induction devices are used); and (3) when R_T/R_S and R_T/R_M are small and the invasion is moderate, all devices have a good response. 11 refs. C. A. F.

2140. Quantitative log analysis. Pt 8. How to determine and interpret water saturation. R. G. Hamilton and P. Charrin. *Oil Gas J.*, 3.6.57, **55** (22), 100.—A nomogram is provided which permits the electric log determination of S_W (water saturation) from a knowledge of a series of resistivity parameters which can be derived from the SP and resistivity logs. Critical water saturations are discussed, and a table is included which shows the minimum true resistivity required for water-free oil or gas production in clean sands, for varying values of porosity, temp, and connate water salinity. A second table provides a means of determining stock-tank oil in place from a knowledge of S_W, porosity, and shrinkage factor. C. A. F.

2141. Automatization of oilfields. S. M. Mukhamietshin and S. Kosieradzki. *Nafta (Krakow)*, 1956, **12**, 252.—One of the biggest fields in Tuymaza district is run by self-controlled equipment. This is pre-set by means of level regulators. Rods are automatically scraped, and the number of people operating the pumps has been substantially cut. M. S.

2142. Consumption of electrical energy during oil well pumping. J. Nawrocki. *Bull. Polish Inst. Petrol.*, 1956, **6**, 7 (suppl. *Nafta (Krakow)*, 1956, **12**).—Studies proved that best results were achieved when not less than ½ pump cyl was filled with crude and that losses on free running pumps due to friction loss outweighed the equilibrium advantages. M. S.

2143. Average cost of oil well washing. R. Stepek. *Nafta (Krakow)*, 1956, **12**, 212–14.—Detailed analysis of costs and results achieved. M. S.

2144. Influence of differential displacement in invaded oil and gas sands on the induction log. A. J. de Witte. *J. Petrol. Tech.*, 1957, **9** (6), 48–50.—Invading filtrate displaces oil and gas more easily than connate water, giving a zone of completely flushed rock near the well, then a bank of connate water, with undisturbed fluid distribution beyond. The connate water bank gives an annulus of low resistivity, which could not occur in a water sand. This is the basis of the displacement logging technique, for if this low exists it will affect electric logs. The induction log will be most affected because of the concentric current flow; the contribution of the virgin formation becomes less significant. The effect of this phenomenon on the induction logs, 5FF27, 5FF40, and 3F60 has been considered. The thickness of the low zone, assumed to have sharp boundaries, has been computed for different degrees of invasion. The resistivity contrasts for the various zones in a clean sand were also calculated, together with the apparent resistivities for infinitely thick beds as obtained by an induction log. Plots were made in which the hole and bed thickness effects were neglected. The ratio of apparent and true resistivity was derived for the case with a low zone present and for that without, and the ratio of these was studied. There are marked differences according to whether there is or is not a low zone effect. The low zone effect reduces the contrast between oil and water sands, and omission of allowance for this effect can be serious in interpretation. Appropriate devices ought to detect the low zone, but a combination of the currently available induction logs of different spacings does not seem suitable. G. D. H.

2145. Composition correlations of natural gas in reservoir engineering problems. W. W. Eckles. *J. Petrol. Tech.*, 1957, **9** (5), 61–3.—Since a large number of well gas samples must be analysed in studying reservoir continuity, the method of analysis must be quick and inexpensive. The mass spectrometer meets this requirement and needs only $\frac{1}{500}$ of the sample needed for Podbielniak analysis. Only 5 peaks are used in the mass spectrometer work, and these refer to CH_4, C_2H_6, C_3H_8, C_4H_{10} and heavier, and O_2. The last is used to correct for air content. The ratios relative to the CH_4 peak are used for correlation. The ratio using butanes and heavier is sometimes affected by sampling in rich gases, and is less reliable than the other ratios.

An example of the use of the technique at Shuteston is given. The technique may also be used for detecting injected dry gas, detecting leaks in dual completions, and studying possible differences between gas associated with oil and that not with oil, as well as any differences between solution and cap gas.

A determination needs one man-hour per sample, and the cost is *ca* $5. Duplicate samples are desirable, and the results should agree within 1–2%. Samples are best taken downstream of a line heater connected to the well being sampled. G. D. H.

2146. Alternate producing and gas repressuring for greater oil recovery. A. B. Cook. *J. Petrol. Tech.*, 1957, **9** (5), 15–18.—In studying the behaviour of semi-depleted oil reservoirs used for gas storage, it seemed that the operation of a gas-storage project would generally gas-sweep a larger part of a reservoir than gas cycling at essentially constant pressure, especially in unfractured reservoirs with large variations in permeability. In gas cycling most flow is through the more permeable zones; in the storage operation there is alternate repressuring and partial depletion (batch gas cycling), involving flow in the less permeable zones also. This alternate compression and expansion procedure can be used in pressure maintenance operations during primary production. It could be used more economically where 2 or more reservoirs are close, because one compressor station could serve all reservoirs if they were operated intermittently, and gas could be shuttled from one to the other. External gas should be added so as to repressure each reservoir completely. Although a considerable amount of oil should be extracted in each cycle, it should not be such as to cause the produced gas–oil ratio greatly to exceed the solution ratio, and natural oil flow should be maintained. 4–8% of the initial oil could be produced from most reservoirs while satisfying these conditions during the first step.

Production data from a semi-depleted oil reservoir used for gas storage and lab data indicate that ⅓ as much oil may be recovered in gas-storage operations as in primary production. The positions of injection and producing wells are important.

This batch cycling technique may be of value in deep reservoirs where secondary recovery by water flooding may not be practicable. Oil vaporization may contribute, especially with high-gravity oil in deep reservoirs, with saturation pressure considerably less than the virgin pressure. G. D. H.

2147. Gas detection by dual-spacing neutron logs in the Greater Oficina area, Venezuela. M. Grosmangin and E. B. Walker. *J. Petrol. Tech.*, 1957, **9** (5), AIMME Tech. Paper No. 4586, 140–7.—It is important to recognize the gas horizons in the Oficina area because there is no market for gas, multiple sands may have gas or oil, gas sands once perforated are difficult and expensive to squeeze off, and testing must be done quickly and cheaply. Most of the sandstones are clean or only slightly dirty, while porosity is often slightly lower in the deeper sands.

The neutron log gives a measurement of the hydrogen index of the formation, and in a clean water sand this is the porosity. The hydrogen concn increases in the order: dry gas, wet gas, retrograde gas, high G.O.R. oil, low G.O.R. oil, water, dead heavy oil. If the depth of filtrate invasion is small and other factors the same, gas sands have a lower hydrogen index (higher neutron deflections) than liq-bearing sands (the difference decreases with increased depth). The index is affected by the gas composition, temp, and especially the pressure.

High neutron deflections can arise from low porosity, while shaliness reduces the deflections: increased hole size decreases deflections.

If 2 neutron logs of different spacing are run, the wider spacing is more affected by the non-invaded part of the gas zone and has a lower hydrogen index; the 2 curves coincide in shales and in oil and water sands. The curves coincide for zero invasion and for deep invasion, but have different values in these 2 cases.

Calibration is important. The wide spacing will give fewer counts/sec than the short spacing. The time constant must be adjusted to keep down statistical variations, and logging speed adjusted to cater for depth lag. Calibration involves adjustment of the sensitivity for long spacing so that the difference in counts for a clean liq-bearing sand of porosity slightly lower than average and for a shale matches that for the short spacing. This permits visual interpretation, for a gas sand will show positive separation.

When the porosity variations are large or calibration of long spacing wrong, plots of counts for the latter are made against counts for the short spacing for shales and liq-filled sands. Gas sands fall below the resultant curve. Some tar sands show a positive separation which is not due to low porosity. G. D. H.

2148. Gas injection performance review of the LL-370 reservoir of the Bolivar Coastal field, Venezuela. T. O. Edison. *J. Petrol. Tech.*, 1957, **9** (6), 19–21.—The LL-370 area in Lake Maracaibo produces from the Eocene B-6 sandstone, which averages 170 ft thick and has permeabilities of 1600 mD updip and 300 mD down-dip. Oil gravity is 26° API at the top and 18° at the bottom. The area is 11,048 acres, broken into 4 sectors by faults which are only partial pressure barriers. No gas cap existed originally; the oil was saturated at the top but not down-dip. Oil output had built up to 60,000 b.d. in 1945 and was kept at about that level until gas injection began in 1954, by which time gas–oil ratios had risen from 500 to 910. Apparently there was good vertical segregation. Wells averaged 2500 b.d. in the early days, but with more completions down-dip and pressure drop fell to *ca* 1300 b.d. Cumulative production was 223,500,000 brl, and the pressure had fallen from 2500 to 1531 p.s.i.a. when gas injection began. A gas cap had developed.

After prolonged studies it was decided to inject 130 M.M.c.f/day. 10 compressors calling for 60,000 h.p. were installed on a platform. 7 stages raised the pressure to 1800–2000 p.s.i. The plant and gas systems cost $20,700,000. 7 injection wells were used, and the injection rate has risen to 162 M.M.c.f/day, and may go to 185 M.M.c.f/day. Tracers were found to take 3·5–6·5 months to reach offset wells, and then seemed to move rapidly down-dip, probably in a thin zone of high gas saturation. The average well producing rate has remained at *ca* 1480 b.d. Mean reservoir pressure has risen slightly.

It is estimated that continued pressure maintenance will give an ultimate oil recovery 43% greater than for natural depletion. G. D. H.

2149. Method of calculating the distribution of temperature in flowing gas wells. L. B. Lesem, F. Greytok, F. Marotta, and J. L. McKetta. *J. Petrol. Tech.*, 1957, **9** (6), AIMME Tech. Paper No. 4599, 169–76.—Assuming constancy of mass velocity, chemical composition, and the product of density and heat capacity, that no horizontal temp gradient exists in the gas, that conduction effects are negligible in the gas stream and in the formation, and that the regional vertical geothermal gradient is constant, equations are derived to describe the temp distribution in the gas stream and in the surrounding formation. If only gas is produced through the flow string only the static geothermal gradient, the physical properties of the gas and the formation, and the dimensions of the well are required for the equations to yield the distribution at any time in a flowing well.

The results of computations from the equations are summarized. For a dry gas the temp profile of the gas stream changes rapidly only in the first day of production. The use of a linear approximation for temp distribution gives a max error of *ca* 4° F for short producing times, and the error grows slowly with time. When liq accompanies the gas the heat capacity of the flowing stream must be obtained from surface temp measurements. G. D. H.

2150. Evaluating D.S.T. data. Pt 4. Finding well-bore damage from drill-stem tests. A. J. Zak and P. Griffin. *Oil Gas J.*, 27.5.57, **55** (21), 125.—The drill-stem test must provide data on well productivity and well-bore damage before completion, and the interpretation of the test must therefore be speedy and accurate. Well-bore damage can be estimated by using an empirical method which requires only pressure build-up data from the test. A formula is given, together with examples of its use. C. A. F.

2151. Temperature effect on formations during jet perforating. R. L. Robinson. *J. Petrol. Tech.*, 1957, **9** (5), 12–14.—In an explosion Self-heating = Heat loss by conduction + Rate of production of heat by chemical reaction. Consideration of the heat flow relationship and the brevity of the reaction shows that the conduction loss is negligible. Jet shooting in wells involves more complex conditions, complicating the calculations and calling for lab studies of the temp reactions. Air tests give the best conditions for max heat flow. No evidence was found of burning or melting in any of the targets tested. Using layers of pine wood separated by cotton cloth and newsprint (self-ignition temp *ca* 446° F) there was no scorching or burning. Shooting in various fluids, some hydrocarbon, the results were similar. Many tests were made on sandstones and limestones, without there being evidence of fusion or other thermal effect. Thus it appears that very little heat is transferred to a formation during jet perforating. G. D. H.

2152. Calculation of water flood recovery from steady-state relative permeability data. J. G. Richardson. *J. Petrol. Tech.*, 1957, **9** (5), 64–6.—It appears that steady-state relative permeabilities to oil and water are independent of the rate of flow and the fluid visc; also that water-flooding performance in homogeneous sands is independent of rate when the capillary pressure gradients are made negligible.

In the lab measurements of steady-state relative permeability a sand column 1 ft long and 1½ inches dia was used. Later the same column was used for water flooding at a

constant rate. The ratio of the water and oil relative permeabilities was calculated as a function of saturation by the Welge technique for 2 water floods, and good agreement with the values for the steady-state measurements was found. Good agreement was also found when the Buckley–Leverett procedure was used in the calculations. This agreement is interpreted as meaning that the microscopic distribution of oil and gas at a given saturation is identical in the 2 cases. The distributions are independent of the visc and rate of water advance. Hence lab relative permeability–saturation data obtained with oil of one visc can be used to predict displacement behaviour of oil of different visc. G. D. H.

2153. Reserves of the Lacq gas field. J.-P. Vacher. *Bull. Ass. franç. Tech. Pétrole*, July 1957, 275–8.—7 wells have penetrated the whole or part of the reservoir; one has stopped at the top of the reservoir, and 2 are being drilled. Production tests have been made on 6 wells. By 1 May 1956 the field had given 80×10^6 m³, 50×10^6 m³ having come from LA 104 during prolonged tests. Tests have shown excellent continuity in the complex of compact limestones and dolomites of the Neocomian–Jurassic. The reservoir pressure is 680 kg/cm² at 3945 m. LA 106 flowed gas at 235,000 m³/day for a drawdown of 15 kg/cm².

Volumetric calculations of the drilled proven reserves give $2{\cdot}5 \times 10^9$ m³/km² (cores indicate average porosity of *ca* 2%; interstitial water was assumed to be 10%). With 40–50 km² proved the figure becomes $100–120 \times 10^9$ m³. Perhaps 70% of the gas in place may be producible. Considerations of the geophysical picture of the structure suggest that the gas in place may exceed 300×10^9 m³. G. D. H.

OILFIELD DEVELOPMENT

2154. Search for big oil pushed. Anon. *World Petrol.*, 1957, **28** (3), 49.—Political developments in the Middle East have stimulated the search for oil in other parts of the world, including Africa, the Indian sub-continent, the Caribbean islands, and Central and S. America. World-wide oil developments are briefly described, by areas and countries. A table shows the number of rotary drilling rigs active, by countries, for Aug. 1956 and Aug. 1957. C. A. F.

2155. Inshore–offshore drilling hits all-time high at Galveston. N. Williams. *Oil Gas J.*, 8.4.57, **55** (14), 177.—There has recently been increased drilling activity in Galveston Bay, Texas, where 14 fields have been found since offshore drilling started in the bay in 1939. 3 of these were discovered in 1956, and 2 in 1957. The recent finds are SW. Red Fish Reef, on the W. side of the bay, and W. Trinity Bay, on the N. side. Only a relatively small part of the bay has been explored, and the total productive area of the fields is less than 6500 acres. None of the fields is comparable in size with the bordering onshore fields. C. A. F.

2156. Offshore lull in Persian Gulf. Anon. *World Petrol.*, 1957, **28** (2), 48.—Offshore exploration in the Persian Gulf has been suspended following the drilling of 2 dry holes and damage to the offshore drilling platform near Qatar. The concession in this area was acquired in 1952, and the first well was drilled *ca* 36 miles NNE. of Doha, 5 miles offshore. It was abandoned at 6700 ft. The second well, at Idd al Sharqi, *ca* 45 miles E. of Doha, was abandoned at 12,000 ft. A third well was planned for 1957, but the mobile drilling platform was damaged by heavy seas.

The most successful offshore work in the Gulf has been in the Safaniya field, which has a proved area of 69,300 acres, producing 27° oil from *ca* 14 wells with pay at *ca* 5560 ft. C. A. F.

2157. India starts test. Anon. *Oil Gas J.*, 10.6.57, **55** (23), 81.—The first Indian government wildcat is being drilled at Jawalamukhi in the Kangra Valley of Punjab. Projected depth is 11,000 ft, and operations are being carried out by Rumanian personnel.

27 wells have now been completed in the Assam Valley since Nahorkatiya was found 4 years ago. The field has a potential of over 50,000 b.d., but is at present shut in. C. A. F.

2158. Oil in the Soviet Far East and Sakhalin. G. G. Rosu. *World Petrol.*, 1957, **28** (1), 40.—Oil was first found in Sakhalin Island off the E. coast of Russia in 1921, and in recent years there has been increased activity in the area of the Okha Rayon in the N. part of the island. Production has increased from 8240 b.d. in 1939 to an estimated 34,300 b.d. in 1955.

The geology of Sakhalin is outlined, there being a narrow belt of Tertiary beds with oil-bearing formations of Lower Pliocene–Upper Miocene age. The richest area is along the NE. coast, where there are a number of fields; the Okha field group, for example, is an asymmetrical structure divided into 3 main blocks by faulting.

The S. half of the island, where there are coal deposits, is less well known geologically, and all the commercial production comes from the N. part. Proven reserves are *ca* 300 million brl, and it is claimed that over 80% of drilling is by turbine methods. Secondary recovery has been carried out in several fields, and hydraulic fracturing has been partly successful.

The quality of Sakhalin oil is variable, and cracking processes are necessary in refining. Most of the crude is transported by pipeline to the mainland, where there are several refineries in the Vladivostok area. C. A. F.

2159. Some economic aspects of the exploitation of the Lacq field. M. Fouchier. *Bull. Ass. franç. Tech. Pétrole*, July 1957, 279–90.—The aim is to produce 20×10^6 m³/day of gas in 1962. This will involve annual outputs of 4×10^9 m³ of purified gas, 80,000 tonnes of C_3H_8, 80,000 tons of sulphur, and eventually 100,000 tons of C_2H_4. The sulphur output would satisfy internal needs and also those of the rest of Europe, yielding economic benefits to France.

Studies of probable consumption show not only variation in daily rate according to the day of the week, but also seasonal variations during the year, while pipeline costs, as well as production and purification costs, fall as the coeff of utilization of the facilities rises. The use of a standing charge and a charge based on consumption would tend to reduce some of the variations, while interruptible contracts and subsurface storage could further reduce variations in load. 2 structures in Aquitaine studied for subsurface storage have proved unsuitable, but one at Lussagnet seems to have a satisfactory sand some 600 m deep.

The 1962 output is equivalent to 4×10^6 tonnes of fuel, or *ca* 5% of the French energy needs. Great difficulties are associated with the Lacq project, and it is necessary to assure the producer of a fair return for his efforts. Industries should not be transferred or transformed in order to use the gas unless it is possible to have continuity of supply over a long period. It is expected that of 13×10^6 m³/day of pure gas, $5{\cdot}5 \times 10^6$ will be consumed in the SW., $1{\cdot}5 \times 10^6$ in the Angouleme–Nantes region, and 4×10^6 in the Lyon–St Etienne–La Creusot area. G. D. H.

TRANSPORT AND STORAGE

2160. Hydraulics for pipeliners. Pt XXIII. Pump station piping. C. B. Lester. *Pipe Line News*, 1957, **29** (6), 23.—Two methods of connecting pumps in a station are described. In the " in and out " system piping stresses due to expansion, mechanical shock, etc., are kept away from the pump by a by-pass containing elbows, tees, etc. In the " straight through " system the by-passes are eliminated, and hence the pressure drop and dead space reduced, but very high stresses are set up at the pump flanges. The nature of these stresses are investigated thoroughly, typical examples are given, and methods of restraint suggested. D. B. S.

2161. Variable-speed drives lower pumping costs. F. A. Moore. *Oil Gas J.*, 26.8.57, **55** (34), 100.—Pipelining power costs were cut by Ohio Oil Co by as much as 25% by use of a variable speed drive between a constant speed motor and pump. G. A. C.

2162. Automation in gas compressor plant operation. E. A. Walsh. *Pipe Line News*, 1957, **29** (7), 30–3.—The use of automation in a large compressor station is described and evaluated. D. B. S.

2163. Emergency shutdown equipment safeguards compressor stations. W. E. Warner. *Oil Gas J.*, 12.8.57, **55** (32), 96.—A remote-control system is described which cuts off gas supply to compressor, blows down all pressure in the yard, and shuts down all operating engines. Explosion danger spots are discussed and start-up procedure outlined. G. A. C.

2164. New developments in compressor-station techniques. P. Reed and R. Kinney. *Oil Gas J.*, 22.7.57, **55** (29), 73.—4 stations—Mount Pleasant, Gladeville, Athens, and Grantville—belonging to Texas Eastern Transmission Corpn are described. 2 completely different types of drive are used to meet a wide range of gas-transmission conditions, and include a 15,000-h.p. single electric motor and 5000- and 7000-h.p. gas turbine units. G. A. C.

2165. Plastic piping—8 years later. W. D. Greathouse and R. L. McGlasson. *Oil Gas J.*, 12.8.57, **55** (32), 106.—Extruded plastics, glass-reinforced plastic, and plastic coatings are discussed, and preferred use for each type shown on maintenance and cost, deterioration in service, temp strength, and creep characteristics. G. A. C.

2166. Getting a pipeline across a river. L. M. Odom. *Oil Gas J.*, 29.6.57, **55** (30), 200.—Pt 3 of this article discusses precautions to be taken in construction, inspection, and testing; with notes on selection of working season for crossing the river. G. A. C.

2167. Pipeline pressure surge problems. II. R. D. Kersten and E. J. Waller. *Oil Gas J.*, 20.5.57, **55** (20), 173.—The application of electronic-computer techniques would ease the preparation of much data in chart and graph form and lessen computation required in analysis of many pressure range problems. G. A. C.

2168. Digital telemetering proves accurate and reliable. M. T. Nigh. *Pipe Line Ind.*, 1957, **6** (3), 45.—Transmission and display of information to a controlling pt from satellite stations is discussed. The new telemetering method used by Service Pipe Line Co for transmitting operating data and supervisory signals proves dependable. R. T.

2169. New techniques for offshore pipelining. Anon. *Pipe Line News*, 1957, **29** (7), 34.—A method for pulling a 22-inch dia, 7-mile long line out to a sea depth of over 300 ft in one continuous move is described. This was achieved using a special design of sled attached to the end of the pipe; this served as a pulling nose and an eventual end-anchor, and also prevented the pipe from burying itself during the pull. D. B. S.

2170. Design and construction of Sun's new products pipeline. H. Muschenheim and C. A. McCutcheon. *Pipe Line News*, 1957, **29** (7), 18–24.—Sun's new 109-mile, 14-inch products line is fully described. Design operating pressure is 1000 p.s.i. D. B. S.

2171. Westcoat's big-inch gas line. First for Canada. C. R. Hetherington. *Oil Gas J.*, 19.8.57, **55** (33), 122.—The 30-inch natural gas pipeline from Peace River to Vancouver is described. The line rises to 4510 ft, and crosses 8 rivers (2 by underwater) and is buried to a minimum depth of 36 inches. Final installed h.p. of compressor stations will be 189,000, with an estimated throughput of 660,000 m.c.f/day. G. A. C.

2172. Thirteen spreads speed new artery. Anon. *Oil Gas J.*, 19.8.57, **55** (38), 235.—Trans-Canada Pipe Lines Ltd are building a 2294-mile natural gas line from Alberta to Toronto and Montreal, which will be the longest in the world. The line will initially deliver 300 m.c.f. gas/day and is designed for 750 m.c.f/day. G. A. C.

2173. Oil line construction lower due to pipe shortage. Anon. *Pipe Line News*, 1957, **29** (6), 18–22.—New pipeline construction in the U.S.A. during 1956 totalled 2750 miles, exclusive of 1136 miles of crude line converted to products service and 96 miles of LPG line converted to crude service. The length, dia, capacity, and cost of the individual contracts that make up these figures are tabulated. D. B. S.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

2174. How sound are refinery economics? R. L. Tollett. *Oil Forum*, 1957, **11**, 48–9.—Recent general increases in posted field prices are defended as being economically sound. Existence of the refinery industry is justified. R. T.

2175. Recent technical developments. Anon. *Petrol. Times*, 2.8.57, **61** (1565), 680.—Brief descriptions are given of various items, including standard tank wagons, a general-purpose spectrophotometer, glass fibre plastic tanks, insulated pipe conduit, oil tank vents, liq level indicators, a process timer, an air injection scavenging fitment for obviating condensation in vacuum pumps, water dist plant, anti-oxidant for polyethylene, a material handling pump, and lab gas meters. G. A. C.

2176. Refiners' crossroads. V. A. Kalichevsky. *Oil Forum*, 1957, **11**, 50–1.—The harmful effects of top-heavy inventories on industrial stability and progress are discussed. The solution of the solvency problem for the petroleum refining industry lies in increase of the val of products recovered from each brl of crude. R. T.

2177. Twenty-five per cent less fuel per barrel of crude. O. F. Campbell. *Oil Gas J.*, 29.7.57, **55** (30), 205.—An air heater

used by Sinclair Refining Co is described which recovers waste heat in flue gases and returns it to the furnace. The company uses *ca* 100 air heaters; *ca* 90 are of the regenerative type, the majority being of the horizontal kind for inlet gas temp of 1400° F, exit flue gas being from 325° to 550° F. G. A. C.

2178. Energy balance for a stripping plant. W. Schiller. *Bull. Polish Inst. Petrol.*, 1956, **6**, 8 (suppl. *Nafta (Krakow)*, 1956, **12**).—2 works were subjected to scrutiny, and results are given in the form of a table. These will serve as a basis for any future investigations and for stricter control. M. S.

2179. Unique gilsonite plant goes on stream. Anon. *Oil Gas J.*, 5.8.57, **55** (31), 58.—Mining and process techniques for gilsonite are described, together with an account of the first plant to produce gasoline from the raw material by the Gilsonite Co, Colorado. G. A. C.

2180. Pumping petroleum products. Anon. *Chem. Proc. Eng.*, 1957, **38**, 364–5.—Brief description of some Sigmund process pumps used in severe conditions in Shell Haven refinery. W. A. M.

2181. Ebullient cooling cuts costs. J. O. Scott. *Oil Gas J.*, 26.8.57, **55** (34), 110.—Sinclair Oil and Gas Co have found that removal of heat from engine lub oil by boiling water improves mobility, simplifies installations, and improves reliability of gas-engine driven compressors. G. A. C.

2182. Refinery construction. Anon. *Oil Gas J.*, 29.7.57, **55** (30), 186.—A plant-by-plant survey is given of construction in the U.S.A. and Canada, with location and projected capacity and completion date. Survey also includes field processing plants and petroleum chemical units. All are arranged alphabetically. G. A. C.

2183. Organization of report office in a refinery. G. Baran and F. Kwasnica. *Nafta (Krakow)*, 1956, **12**, 215–21.—In any works such as a refinery working 24 hr/day, continuity is very important and the paper gives a method for keeping uniform records. M. S.

2184. Centrifugal pump packings and seals. Pt 3. Mechanical seals. H. Woodhouse. *Petrol. Refin.*, 1957, **36** (4), 207–11.—This article discusses in detail the application of mechanical seals, giving an outline of the basic elements of such a seal and discussing the advantages of their use in certain cases. Seals for use at high pressures are discussed under a separate heading. Care of seals is stressed, particularly with regard to proper application and handling. J. R. T.

2185. Goodloe column packing—a new knit packing material for vapour-liquid contacting operations. L. B. Bragg. *Industr. Engng Chem.*, 1957, **49**, 1062–6.—The use of a knitted wire mesh packing was investigated in columns up to 4 inches in dia, using a packed height of *ca* 36 inches. Pressure drop was found to be extremely low, particularly at the flooding point, when compared to other high efficiency packings. The packing has not only a high capacity, being about equal to that of a bubble cap tray, but also a high efficiency, and HETP values less than twice those of Stedman packings were obtained. Liq hold-up is about average. D. B. S.

2186. Fluid distribution in process equipment. V. E. Senecal. *Industr. Engng Chem.*, 1957, **49**, 993–7.—The importance of good fluid distribution in process equipment is discussed and methods of achieving it described. A classified bibliography is included. D. B. S.

2187. Flow distribution and diffusion in fixed-bed two-phase reactors. L. Lapidus. *Industr. Engng Chem.*, 1957, **49**, 1000–6.—Residence time studies were carried out in a 2-inch-dia packed bed reactor using concurrent flow of liq and air in order to investigate both flow distribution and hold-up characteristics. A close approach to plug flow was observed using a non-porous packing, but distorted curves were obtained for a porous packing. This difference was found to be due to the mass transfer of tracer from within the internal voids of the packing. Pulse-type tracer input curves were found to be only slightly affected by mass transfer, and therefore produced results identical to those for non-porous packing.

A method for investigating the behaviour under conditions of high temp and pressure is suggested. D. B. S.

2188. Pressure drop in air-solid flow systems. N. C. Mehta, J. M. Smith, and E. W. Comings. *Industr. Engng Chem.*, 1957, **49**, 986–92.—Pressure drop data obtained for the transport of glass microspheres by air in a ¼-inch-dia pipe were found to be correlated by a Fanning-type equation. The equation includes terms for particle velocity and solids flow rate, and defines a friction factor which is independent of solids flow rate or direction (vertical or horizontal) but dependent on the Reynolds No. of the transporting fluid and the particle size. D. B. S.

2189. Non-isothermal flow of viscous non-Newtonian fluids. R. E. Gee and J. B. Lyon. *Industr. Engng Chem.*, 1957, **49**, 956–60.—Relationships for the laminar flow of viscous non-Newtonian fluids through circular channels were developed mathematically and checked experimentally using an acrylic resin. Equations could be used to predict the effect of pressure drop, fluid temp, channel geometry, and fluid properties on the steady state flow. D. B. S.

2190. Turbulent concentration fluctuations in a packed bed. J. M. Prausnitz and R. H. Wilhelm. *Industr. Engng Chem.*, 1957, **49**, 978–84.—Theoretical and experimental relationships between concn fluctuations and turbulence parameters in a packed bed are explained. D. B. S.

2191. Flow patterns for predicting shell-side heat transfer coefficients for baffled shell and tube exchangers. R. K. Gupta and D. L. Katz. *Industr. Engng Chem.*, 1957, **49**, 998–9.—The flow pattern on the shell side of a heat exchanger may be classified into 3 zones—longitudinal flow, true cross flow, and eddy or dead zones. Heat transfer coeff for the eddy zone are computed from experimental data and by using equations from the literature for longitudinal and true cross flow. D. B. S.

2192. How to calculate tube sheet diameters. I. Granet. *Petrol. Refin.*, 1957, **36** (4), 194.—The design of heat transfer equipment frequently involves the estimation of the size of tube sheet required to accommodate a given number of tubes on various spacings. This article presents a method which is simple and in principle can be applied to any type of tube layout. Because the detailed calculations are tedious and time-consuming, emphasis has been placed on equilateral triangular tube spacings. Curves derived from the calculations have been found to have more than adequate accuracy for design purposes and enable the quick verification of the feasibility of any set of design parameters. Equations and detailed calculations are given for the following cases: single pass unit with (1) tube on centre, (2) tube off centre, and U-tube unit with (1) tube on centre, (2) tube off centre. J. R. T.

2193. Compare finned and plain tubes. M. Hobson and J. H. Weber. *Petrol. Refin.*, 1957, **36** (5), 239–42.—Heat transfer and pressure drop data are calculated for 4 concentric pipe exchangers; 3 employing different types of extended surfaces as the inner element and one a plain tube. The performance of the various exchangers is presented in graphical form. Comparison of the heat transfer performances shows the

superiority of the extended surface equipment, while comparison of the pressure drop characteristics shows the advantage of the plain tube exchanger. Both characteristics are combined then in a "power performance factor." This factor shows that the plain tube exchanger is less desirable than either the transverse finned or continuous longitudinal finned equipment, but more desirable than the spined tube exchanger. J. R. T.

ABSORPTION AND ADSORPTION

2194. Better stripping and absorption factors. R. O. Shelton. *Petrol. Refin.*, 1957, **36** (4), 153.—A series of charts is presented which permits rapid evaluation of average absorption or stripping factors in a separation tower. The averages obtained can be used in conventional calculation methods to compute the separation which can be achieved in a tower. The average stripping and absorption factors are based upon the assumption that the factors on successive stages differ by a constant multiplying factor (geometric gradient). The parameters involved in the determination of average factors are the terminal conditions of a given tower. J. R. T.

2195. Adsorption—the process to watch. W. M. Dow. *Petrol. Refin.*, 1957, **36** (4), 141.—Packaged adsorption units which utilize fixed beds of silica gel or activated charcoal may well be the answer to the problem of efficiently and economically extracting raw gasoline from relatively small natural gas streams. An example of such an adsorption unit which has been developed and tested is described in detail. Although developed for the extraction of raw gasoline from relatively small and lean natural gas streams, it is also applicable to rich gas streams and appears to be capable of being developed into a large central processing plant to recover multiple liq products. J. R. T.

2196. High ethane recovery, better efficiency. H. C. Givens. *Oil Gas J.*, 12.8.57, **55** (32), 104.—A new absorption system is described which provides, at the La Gloria Oil and Gas Co, Falfurras, Texas, plant, a product gas of *ca* 53% ethane and 47% methane. A flow sheet is given, amply annotated. G. A. C.

SOLVENT EXTRACTION AND DEWAXING

2197. Examine solvent dewaxing. R. Rautschka, H. Poell, and F. Pass. *Petrol. Refin.*, 1957, **36** (4), 183.—The second of a series of 2 articles, this deals with the graphical calculation of dewaxing problems by ternary diagrams. The construction of the ternary diagram from the solidification diagrams (plots of temperature *v.* composition) of the 3 binary mixtures is described and the method of determining the "fix points" outlined. Applications of these diagrams to calculation of the amount of solvent required for a certain operation, the unknown wax content of an oil, and calculation of dewaxing at higher temp at which the solubility of wax can no longer be neglected, are discussed. J. R. T.

2198. How Esso modernized dewaxing-plant controls. L. Anderson and R. Silva. *Oil Gas J.*, 22.7.57, **55** (29), 82.—An automatic system to control "hot-washing" of filters and depressurizing of scraped-surface heat exchangers has been installed at the M.E.K. dewaxing plant of Esso Standard Oil Co, Bayonne, N.J. The result has been an increase in plant throughput, process deviations held to a minimum, fuel consumption reduced, and increased efficiency of solvent—recovery—system and ammonia compressor operation. G. A. C.

2199. Low pour oils made by urea process. I. A. Hoppe and H. Franz. *Petrol. Refin.*, 1957, **36** (5), 221–4.—The results of an investigation into the use of urea in the production of low-pour-point gas oils are reported. Methylene chloride was chosen as the solvent in the formation of the urea–hydrocarbon complex, as it has an extraordinary advantage over other similar solvents in that its b.p. of 41° C lies in the range specifically used for max adduct formation. The effect of various solvents towards non-adduct-forming oily constituents, and thus on the pour point of a spindle oil, is shown. The difficulties arising in the choice of a suitable solvent for the urea itself are discussed, water and the lower alcohols being among the most important ones used. A brief description of a commercial plant based on the technical data obtained is included. J. R. T.

2200. Urea dewaxing gets more emphasis. T. H. Rogers *et al.* *Petrol. Refin.*, 1957, **36** (5), 217–20.—A new separation technique that operates at ordinary temp and offers a possible approach to the manufacture of low-cold-test oils from waxy crudes is described. In this technique, known as urea adduction, separation of mixtures of organic substances is based on the formation of a solid complex. Initial lab studies of the reaction variables are described, development of the process outlined, and a description of the resulting commercial plant given. J. R. T.

2201. Propane removes asphalts from crudes. H. N. Dunning and J. W. Moore. *Petrol. Refin.*, 1957, **36** (5), 247–50.—An extensive lab study has been made to determine optimum conditions for removing nitrogenous, metallic, and asphaltic materials from a Mid-Continent crude oil by precipitation with propane. The conditions for precipitation have been investigated throughout the temp range from 120° to 180° F with propane–oil ratios from 4 : 1 to 16 : 1. The efficiency of precipitation was determined by asphaltene yields and nitrogen contents of the asphaltenes and raffinates. This deasphalting process removes much of the ash, nickel, vanadium, and nitrogen from the oil and results in marked decreases in its visc and carbon residue. The method is shown to be highly versatile and applicable for the improvement of petroleum stocks and fuels. J. R. T.

CRACKING

2202. How kaolin works for cat cracking. D. Beyler, J. B. Maerker, and J. W. Schall. *Petrol. Refin.*, 1957, **36** (5), 213–15.—Several commercial cracking units which previously used synthetic cat are now using kaolin. This article lists several advantages of kaolin over the conventional bentonite clay and synthetic cat. Commercial and pilot plant data are presented which show how the cracking characteristics of kaolin compare with those of the other cat cracking cat. J. R. T.

2203. Two new Sulfining units exceed design capacities. L. Resen. *Oil Gas J.*, 12.8.57, **55** (32), 99.—Process and operating data are given for units at Port Arthur, Texas, with a combined design capacity of 45,000 b.d. charging segregated streams of light cat gas oil and W. Texas furnace-oil dist. G. A. C.

2204. Cosden juggles pumps in cat cracker research. L. Resen. *Oil Gas J.*, 26.8.57, **55** (34), 98.—Minimum new equipment was required by Cosden Petroleum Corpn in expanding its cat cracking unit at Big Spring, Texas, since existing equipment was utilized to the fullest extent and equipment unable to meet new requirements was transferred to other use. A table details changes. G. A. C.

2205. Cracking with high alumina catalyst. R. W. Roquemore and C. D. Strickland. *Petrol. Refin.*, 1957, **36** (5), 231–3.—The study reported in this article shows that commercial

scale fluid cat cracking of uncontaminated gas oils with 25% alumina cat provides a change in product distribution relative to cracking with 13% alumina cat. The high alumina cat produces more C_5–430° F naphtha at the expense of butane and lighter products, and retains a higher activity. At the same equilibrium cat activity level a 50–60% reduction in cat make-up rates could result with the higher alumina cat. Changes in the gas oil feed made it impossible to determine whether the high alumina cat was more resistant to contamination. This cat did, however, result in lower stack losses through a mechanism which is not fully understood.
J. R. T.

2206. Catalysts in hydroforming operations. E. G. Curphey. *Petrol. Times*, 16.8.57, **61** (1566), 705.—The history of the hydroforming operation is given, with thermodynamical considerations; static bed, fluidized and some modern techniques are described, and up-to-date theoretical mechanisms are considered. G. A. C.

2207. Find catalyst density with isotopes. R. H. Hunt *et al.* *Petrol. Refin.*, 1957, **36** (4), 179.—A new research technique using radioisotopes for the quick determination of cat distribution in all phase regions of cat cracking units is described. The method is not limited by the size of the vessel or line under consideration, but is limited only by practical considerations of the quantities of γ-emitting material which can be handled safely. All equipment is externally mounted and does not interfere with the process. The method is applicable to any 2-phase system in which the phases differ sufficiently in density or in mass absorption coeff to permit accurate measurement. J. R. T.

HYDROGENATION

2208. Necessity for knowledge of porous systems and their investigation methods in low-temperature hydrogenation (TTH process). (In German.) W. Greber. *Erdöl u. Kohle*, 1956, **9** (9), 616–20.—Process economy depends on purity of injected product. To ensure purity the tar is filtered in 2 stages and centrifuged. Washing with H_2O removes solubles from the ash, *i.e.* alkalis and Ca and Fe phenolates. Operational difficulties caused the use of new methods to clarify quality fluctuations of the high-pressure cat, and the changed filtration rate of the lignite low-temp-carbonization tar. Cat and filter cakes constitute porous systems, originating from aggregates of uniform origin under different experimental conditions. Therefore the idea of the aggregate, also its description, are discussed through the grain numerical distribution or grain wt distribution. Filtration phenomena in lignite low-temp-carbonization tars are described and filtration compared with that of paraffin slack wax. Results of measurements for the individual porous systems—filter cakes, cat, cokes—are discussed. Differences between micro- and macropore systems as regards product quality can be seen. Connexions between an aggregate and the pore system arising from it are illustrated by a series of experiments with tar and ground material. R. T.

2209. The C.T.R.A. hydro-refining process. Anon. *Petrol. Times*, 30.8.57, **61** (1567), 757.—Further details are given of the Coal Tar Research Association's process for the hydrorefining of crude benzoles, naphthas, and other hydrocarbon oils. A flow diagram is provided. G. A. C.

ALKYLATION

2210. Alkylation unit modifications improve operating conditions. L. Resen. *Oil Gas J.*, 12.8.57, **53** (32), 94.—Modifications to the Kellogg designed El Paso refinery unit of Standard Oil Co have resulted in production of an average light alkylate product in excess of 1450 b.s.d. when charging olefin with a high proportion of propylene. Tables show operating conditions and ASTM dist figures of light and heavy alkylate.
G. A. C.

ISOMERIZATION

2211. When to isomerize pentane and hexane fractions. H. R. Grane, J. K. Ozawa, and G. R. Worrell. *Petrol. Refin.*, 1957, **36** (5), 172–6.—The conversion of *n*-pentane and *n*-hexane to their isomers gives a very substantial octane increase. The Pentafining process effects this isomerization with little yield loss. In this article data are presented for *n*-hexane isomerization, showing how and when C_5 and C_6 Pentafining should be installed in a typical refinery. The selectivity of the cat is demonstrated with once-through yields for C_5's and C_6's. The economics of isomerization are clarified by showing applications to several typical refinery situations. J. R. T.

2212. Upgrading saturates with dehydro-reforming. C. K. Donnell, A. Schneider, and D. H. Stevenson. *Petrol. Refin.*, 1957, **36** (5), 186–8.—Dehydrogenative reforming has been shown to be an effective means for upgrading low-boiling saturate fractions to high octane products. Use of a rugged chromia–alumina cat in a cyclic process at close to atm pressure resulted in debutanized yields of 80% of 95 Research O.N. reformate (leaded) from 57·8 Research O.N. clear C_6–C_7 saturates. Little change in vapour pressure and production of C_3 and C_4 olefins permitted potential yields of 10 lb R.v.p. gasoline to be approx 15% by volume greater than the debutanized yield. Other light fractions, including the C_5 fraction, can be handled readily by the same technique.
J. R. T.

2213. Upgrading pentanes with catalytic dehydrogenation. H. Shalit *et al.* *Petrol. Refin.*, 1957, **36** (5), 183–5.—Cat dehydrogenation of virgin C_5 fractions is a method of increasing their O.N. The results of a preliminary process study of pentane dehydrogenation over a Houdry chromia–alumina cat are reported in this article. The results show that this process can produce higher octane ratings than those possible by isomerization, but that, for octane ratings up to *iso*-pentane, yields are less than isomerization. J. R. T.

2214. Isomate process adapted to motor fuel. H. G. Krane and E. W. Kane. *Petrol. Refin.*, 1957, **36** (5), 177–82.—A description of this isomerization process for upgrading C_5's and C_6's, using the $AlCl_3$ complex cat at low temp, is given. The low temp employed favour the formation of the highly branched isomers having the highest O.N. An isomerized light naphtha of 96 to 98 Research O.N., leaded, can be produced without recycling. Recycling will produce a product of up to 106 O.N. A cost comparison between the Isomate process and the cat reforming process is developed, indicating reasons for using isomerization before cat reforming potential is reached. J. R. T.

CHEMICAL AND PHYSICAL REFINING

2215. Steam-flash vaporization of multi-component mixtures. C. D. Holland and W. B. Hayes. *Petrol. Refin.*, 1957, **36** (4), 203.—Equations describing 2 general cases of steam-flash vaporization are stated. The first case considers the partial vaporization of a multi-component mixture of volatile cpds plus any number of non-volatile components. The non-volatile components are taken to be soluble in the volatile components. An equation is presented by which the vapour formed from the volatile components and the corresponding liq may be calculated for any steam rate up to and including rates beyond those at which condensation occurs. This

equation may be solved by use of Newton's method. The second case assumes that the non-volatile components do not alter the mol fractions of the volatile components. The equations give the steam requirement for complete vaporization of the volatile components. 2 examples are included which illustrate the application of the equations. J. R. T.

SPECIAL PROCESSES

2216. Effect of ionizing radiation on solid catalysts. R. W. Clarke and E. J. Gibson. *Nature, Lond.*, 1957, **180**, 140.—In the cat synthesis of hydrocarbons from CO and H_2, radiation doses of up to 2×10^7 r (Co-60 γ radiation) effect no change in the activity of a cobalt/thoria/magnesia/kieselguhr cat. With unreduced iron cat of particle size 100–200 μ, radiation doses of $1–5 \times 10^7$ r produced 10–40% increase in the rate of reaction, and the high activity was maintained to the end of test (300 hr). For particles of size 0·2–5 μ the increase in activity was of the order 40–60%, but for particles of range 400–600 μ there was no increase.

It is deduced that irradiation produces changes involving the partial reduction and formation of iron carbides. H. C. E.

2217. Dephenolating low-temperature carbonization benzole by continuous process with NaOH. J. Marciniak *et al.* *Bull. Polish Inst. Petrol.*, 1956, **6**, 7–8 (suppl. *Nafta* (*Krakow*), 1956, **12**).—2 glass columns 180 cm × 3·5 cm were used. *Ca* 150 cm of the length near the top would contain pure benzene and the bottom 20 cm Na Phenate. Similar experiment was conducted using H_2SO_4 to remove pyridine bases, and optimal conditions are deduced for both. M. S.

PRODUCTS

CHEMISTRY AND PHYSICS

2218. Radiolysis of liquid paraffins. W. H. T. Davison. *Chem. & Ind.*, 1957, 662–3.—Pure C_5–C_7 *n*-paraffins were irradiated with 2-MeV electrons and with ^{60}Co γ-rays. Yields of products are given for *n*-hexane, those up to C_3 being analysed by GLC. These lower products contain a high proportion of alkenes. The parent cpd becomes unsaturated and intermediate (C_{7-11}) and dimeric alkanes are formed; these alkanes can be captured in radical traps, *e.g.* I_2 yields alkyl iodides. A scheme is proposed to explain the known facts, and has been checked by mass spectra measurements. Ratios of obs/calc for unsaturated/saturated C_2 and C_3 products were 0·6 and 0·7, respectively, which is regarded as reasonable agreement. For ratios of C_2/C_1 and C_3/C_1 the obs/calc ratios were 0·3 and 0·2; these low yields are attributed to the cage effect. W. A. M.

2219. Water solubility in organic solvents. N. W. Luft. *Industr. Chem. Mfr.*, 1957, **33**, 446–7.—Nomogram (40–10,000 p.p.m.; −20° to 120° C) for 17 solvents, including *cyclo*-hexane, hexane, benzene, toluene, xylene. V. B.

2220. Point of attack in hydrocarbon oxidation. R. Bunt, F. B. Ebeid, and G. J. Minkoff. *Nature, Lond.*, 1957, **180**, 188.—Kinetic studies *in situ* on an i.r. spectrometer of the slow reaction of mono-deuterated propanes with small amounts of O_2 under conditions which avoided C–C fission indicate that, at 360° and 420° C, attack on the secondary C–H or C–D is *ca* twice as fast as that on the corresponding primary bond.

In another experiment the products of the slow oxidn of *n*-heptane at 200° C contained aldehydes from C_2 to C_6; at 280° C, however, the extent of the reaction is small and the main products were propionaldehyde and *n*-butyraldehyde.

It is suggested that oxidn initially involves attack at a secondary C atom, followed by fission of one of the central C–C bonds. The higher aldehydes are then formed through attack on the primary C atom by chain carriers. H. C. E.

2221. Oxidation of pentane in mixtures with air and the negative temperature coefficient of reaction. R. O. King, S. Sandler, and R. Strom. *Nature, Lond.*, 1957, **180**, 335.—Stoichiometric mixtures of *n*-pentane and air were passed through an annular reactor of dia 18 mm and 1 mm width, maintained for a length of 6½ inches at a fixed temp.

With air supplied at $v = 400$ ml/min, reaction began at 650° C and ignition occurred at 747° C. This high temp reaction remained substantially unchanged until $v = 100$ ml/min, with the mol ratio O_2 reacted/pentane rising to 5·0. When $v \leqslant 200$ ml/min, a low temp reaction also occurred between 420° and 505°, and at the highest reaction rate, a $v = 50$ ml/min and temp 450°, the mol ratio O_2 reacted/pentane was 1·3. The products of the low temp reaction included aldehydes and acids, and those of the high temp reaction CO and CO_2.

At $v = 50$ ml/min the low and high temp reactions were not separate, and ignition was not obtained even at 800°, where the mol ratio O_2 reacted/pentane = 5·75 and the reaction products were CO_2 and H_2O only.

The low temp reaction is shown to be a surface phenomenon. H. C. E.

2222. Prediction of vapour–liquid equilibrium data for binary hydrocarbon systems with one aromatic component. B. C. Y. Lu and W. F. Graydon. *Industr. Engng Chem.*, 1957, **49**, 1058–60.—An empirical equation for predicting the equilibrium data is suggested in which only a knowledge of the properties of the pure components is required. Methods for predicting the constants required are described. D. B. S.

ANALYSIS AND TESTING

2223. "Mechanical Engineering Research, 1956." Anon. *Petrol. Times*, 16.8.57, **61** (1566), 717.—A brief review is given of the above publication by the DSIR, and deals with the organization of the MERL lab work and of some of the investigations carried out, including dynamic conditions in journal bearings and pitting in gears. G. A. C.

2224. Determination of aromatics in medicinal white oils. K. A. Fischer, G. Brandes, and W. Gohdes. *Pharm. Ind.*, 1957, **19**, 293–6.—Estimation of % C_A by *n–d–M* method or by i.r. spectra (*cf* Abs. **532**, 1957) is insufficiently sensitive for white oils, where % C_A is $\ll 1\%$. Absorption at 2700 Å is very dependent on extent of refining, and u.v. spectra of various aromatic cpds show marked increase of ε_{max}/C_A for condensed ring systems over value for single-ring substances, thereby permitting detection of 1 p.p.m. (or less) of the former in white oils. Commercial products had % C_A 0·027–0·088 for liq paraffins and 0·18 for a pharmaceutical white oil. Removal of added (0·03–0·1%) polycylic aromatics (*e.g.* chrysene, 3 : 4-benzpyrene) from liq paraffin was complete after treatment with 10% (vol) fuming (20% free SO_3) H_2SO_4. No relationship was found between fluorescence intensity and % C_A. V. B.

2225. Investigations of tritium bremsstrahlung as a means of determining sulphur and tetra-ethyl lead in hydrocarbons. M. M. Kannuna. *J. Inst. Petrol.*, 1957, **43** (403), 198–202.—Bremsstrahlung emitted from a source consisting of tritium absorbed on zirconium foil are used to determine the S and

TEL contents of hydrocarbons. The apparatus, and its calibration, using an Al reference absorption curve, are described. The sensitivity of the method compares favourably with other methods. 16 refs. C. B.

2226. Role of the chemical laboratory in the control of technological processes and quality of production of an oil refinery. A. Ciolkosz. *Nafta (Krakow)*, 1956, **12**, 253–4.—Where crudes of various origins are supplied for treatment, raw materials must be controlled as well as semi-finished products and all chemicals to be used on the plant, and in the lab itself control of fuel is also included. Prescribed tests and methods are briefly given. M. S.

2227. Vapour detectors for gas chromatography. D. H. Desty. *Nature, Lond.*, 1957, **180**, 22.—Report of a symposium at Oxford, May 1957. Among the subjects discussed were the use of the gas density balance at high temp, the hydrogen flame detector, and one utilizing a low-pressure electric discharge. H. C. E.

2228. Shock resistance of paste wax. F. E. Chapman, D. R. Zimmerman, and P. D. Brusko. *Soap, N.Y.*, July 1957, **33** (7), 66.—A practical lab method and apparatus for quantitatively measuring the paste strength of a given composition. Basically the paste wax under examination is subjected to a shock applied by means of a free swinging pendulum. Determinations of 8 formulations are given. D. K.

2229. Non-ionic surfactants. L. E. Weeks, M. E. Ginn, and C. E. Baker. *Soap, N.Y.*, Aug. 1957, **33** (8), 47.—An accurate reproducible routine gravimetric method is described for the determination of the non-ionic portion of a surfactant mixture following sorption of some surfactants from an aq ethanol soln on anion and cation exchange resins. G. A. C.

CRUDE OIL

2230. Survey of Polish crudes by paper chromatography. S. Krol. *Nafta (Krakow)*, 1956, **12**, 242–6.—Although activity of certain charcoals was first observed in 1773, the chromatographic method was not developed until 1861. D. T. Day in 1897 used fuller's earth to analyse some oils, and M. S. Tsviet, a Russian Professor at Warsaw in 1903–6, established this method for botanical research. Engler, Gurvitch, and Ubbelohde all contributed to the development of the method. For the current analysis Polish filter papers were extracted with $HCCl_3$ prior to beginning the work. Chloroform and C_6H_6/alcohol (2 : 1) were used as eluents. Simultaneously, usual tests were conducted to determine other properties of the oils. U.v. light was used for development of the chromatograms. 6 crudes were examined, and the relationship between fluorescence, density, and mol structure has been established. M. S.

GAS

2231. 5 trillion cubic feet of gas ready for Westcoat. C. R. Hetherington. *Oil Gas J.*, 19.8.57, **55** (33), 127.—A summary is given of the operations of Pacific Petroleum Ltd in the Peace River country of British Columbia and Alberta. Gas and reservoir characteristics are reviewed, completion techniques described, and by-product processing, manufacturing, and markets discussed. G. A. C.

GAS OIL AND FUEL OIL

2232. Hydrogen is produced from fuel oil in French plant. Anon. *Oil Gas J.*, 29.7.57, **55** (30), 202.—The Texaco process for production of hydrogen has been commercially operated at the Paimboeuf, France, plant of Etablissements Kuhlmann. Basically the process involves passing a mixture of heated fuel oil at high pressure and steam into a special burner and mixing with compressed oxygen, the reactants flowing into a converter maintained at pressure and high temp. G. A. C.

2233. Maximum gas concentration at ground level from industrial chimneys. A. C. Best. *J. Inst. Fuel*, 1957, **30** (197), 329.—The max concn of waste gas likely to occur at ground level in any weather conditions can be estimated if the height to which the gas plume will rise is known. The results of using 3 known formulæ for calculating this figure have been considered. 4 literature refs and discussion. D. K.

LUBRICANTS

2234. Lubrication with colloidal graphite and molybdenum disulphide. C. C. Richards. *Gas Oil Pwr*, 1957, **52**, 170.—Colloidal graphite, used as a suspension in water, alcohol, white spirit, or mineral oil, cannot be removed by normal engine filters. It is found that graphite forms a film, of the order 0·00001 inch thick, on metal bearings, etc., which is resistant to corrosion and abrasion under high temp and pressure. It will function at temp up to 600° C.

MoS_2 is stable up to 350° C, but possesses a coeff of friction which falls with increasing load. It is a desirable lubricant for heavily loaded gears, etc., and as a coolant additive in cutting oils for use with Ti and high-tensile steels. H. C. E.

2235. Preventive maintenance of compressor engines by oil analysis. D. V. Kniedes. *Pipe Line News*, 1957, **29** (7), 38–41.—Lub oil samples from compressor engines may be spectrographically analysed for metals content, and over a period the results used to detect how much and where engine wear is taking place. Typical results and difficulties associated with the method are discussed. Information from engines using detergent oils could not always be satisfactorily resolved. D. B. S.

2236. Atomic experiments develop radiation-resistant lubricants. Anon. *Oil Gas J.*, 26.8.57, **55** (34), 97.—Radiations have a profound effect on the structural and physical properties of an oil, cross-linking eventually occurring. Shell's Thornton Research Centre has exposed oils and greases to radiations and studied changes, with the result that with a better insight into complex reactions, oils have been formulated to withstand high dosages of particles and rays. G. A. C.

2237. The flash temperature parameter: a criterion for assessing E.P. performance on the four-ball machine. T. B. Lane. *J. Inst. Petrol.*, 1957, **43** (402), 181–3.—Assuming that the load-carrying ability of a lubricant is characterized by a critical temp for failure, the author derives an expression for the max temp rise, the temp flash, in the 4-ball machine. This is $\Delta T = W/d^{3\cdot4}$, where W is the applied load and d is the wear-scar dia, in its simplified form. The flash temperature parameter is defined as the max value of ΔT, obtained throughout a run with varying loads, and is easily calculated from the wear–load curves. As this represents the most severe condition for successful lubrication to occur, it is regarded as a criterion for performance. 6 refs. C. B.

2238. Fireproof steam turbine lubricants. First considerations and perceptions from U.S.A. practice. (In German.) E. Knoop. *Erdöl u. Kohle*, 1956, **9** (9), 613–16.—Causes of numerous destructive fires in U.S. power stations are discussed. Researches to develop cheap synthetic lub are reported on liq with high H_2O addn, synthetic water-free products, and silicones. Tests show that synthetic lub—

compared with a petroleum turbine oil with additive—show equally good properties as regards lubricity, thermal conductivity, and rust prevention. As regards wear resistance, pressure stability, and satisfactory separation from penetrated water, it is superior. It is inferior as regards ASTM oxidn resistance. A V.I. improver was found of higher shearing strength, by using which visc of the lub in operation does not decrease. An absolutely new Socony Mobil Oil Co product has V.I. 110 with vise *ca* 3·5° E at 50° C. The problem of insulating varnish softening on the generator windings, with oil leakage and foaming of the product, remains to be solved. R. T.

BITUMEN, ASPHALT, AND TAR

2239. Practical applications of bitumen in the oil industry. K. A. Wheeldon. *Inst. Petrol. Rev.*, Aug. 1957, **11** (128), 220.—The various uses of straight and blown bitumens are given, and include thermal insulation (both hot and cold), damp and water proofing, roofing and damp courses, floors, adhesives, glazing cpds, paints, roads, tank foundations, and steelwork protection. G. A. C.

2240. Causes and forms of blister formation. A. W. Rick. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (12), 450–1.—Blisters are blown in most cases only by air–steam mixtures. The assistance of the residue from the solvent used to dissolve the bitumen or tar is limited almost solely to consistency changes. These increase blister susceptibility, but not blister formation in itself. Blister prevention, results of formation, and removal are discussed. R. T.

2241. Bitumen emulsions—recent advances in knowledge of their properties. Pt 2. (In German.) H. Nussel and A. Buhs. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (12), 444–9.—Factors influencing the stability of oil emulsions—irreversible lyophobic colloids—are discussed. Stability in storage depends upon hydration and the elec potential—arising under the influence of elec double layer formation in the phase interface—and its breakability, *i.e.* its behaviour against stones, etc., effected by alkali adsorption by the stones. This adsorption influences the aq-phase composition and causes bitumen coagulation. Oil droplet coagulation is stopped by introducing surface-active substances. These are adsorbed into the phase interface in a monomolecular layer, the oleophilic group of the mol adhering to the oil phase, the hydrophilic end penetrating the H_2O phase. Eff of the oleophilic group depends largely upon chain length. Ionogenic acids and basic groups—leading to formation of anionic and cationic substances—are hydrophilic. Carboxylic acids, sulphonic acids, and fat alcohol sulphonates are anion-active emulsifiers. Quaternary ammonium cpds and amines are cationic emulsifiers. Sp substances, *e.g.* casein, have a special position as emulsifiers; they lead to emulsions in which stability of the hydrate envelope effects an extensive insensitivity of the emulsion. R. T.

2242. All electrically heated asphalt plant. Anon. *Rds & Str.*, Aug. 1957, **100** (8), 155.—A 4000-lb plant is described, manufactured by Standard Steel Corpn and operated by Armour Excavating Inc. The 4 12,000-gal tanks for asphalt materials are fitted with low-density 2-watts p.s.i. electric tubular heaters. G. A. C.

SPECIAL HYDROCARBON PRODUCTS

2243. Transformer oil preservation. J. R. Meador and N. E. Dillow. *Amer. Inst. Elect. Eng.*, 1957, Preprint CP 57–153. 7 pp.—Conditions in N_2-sealed transformers are considered, and it is shown that N_2 content of oil can rise to *ca* 12 vol% at on-load temp. Pressure drop consequent on temp decrease when load is reduced results in super-saturation (which will occur if N_2 content exceeds *ca* 9–10%), leading to bubble formation. Lab tests indicate that such bubble formation will occur in pressure range in gas space >2·5 p.s.i., or even less, dependent on pump design if forced circulation is used. Bubbling is generally undesirable, as it can reduce dielectric strength; it can be reduced by limiting max pressure range in gas-sealed transformers or eliminated by use of a constant pressure (*e.g.* conservator) system. V. B.

2244. External area effect for large area electrodes for the electric breakdown of transformer oil. K. H. Weber and H. S. Endicott. *Amer. Inst. Elect. Eng.*, 1957, Preprint No. 57–752, 15 pp.—Further tests (*cf.* Abs. **1132**, 1957) with the 4 electrodes previously used and with an additional large electrode, giving an overall electrode area ratio of 700 : 1, confirm the earlier findings on reduction of breakdown strength with increasing electrode area; theoretical and obtained results are compared. V. B.

2245. Paper cable saturants. European preferences and selection. G. E. Bennett. *Amer. Inst. Elect. Eng.*, 1957, Preprint 57–638, 26 pp.—European preference is for oil–rosin blends as against purely hydrocarbon materials more commonly used in the U.S.A. Electrical characteristics of such blends are considered, especially the greater ageing resistance (*i.e.* retention of good electrical characteristics) as compared with mineral oil, due to the stabilizing effect of rosin. Details of a lab ageing test (24 hr, 120° C, stagnant in air, Cu cat) are given. Rosin addition (approx 20%) also gives *ca* 30% increase in impulse strength (an effect possibly independent of the visc increase), increases gas absorption under electrical stress, and causes a marked, and desirable, decrease of V.I. Hollow core cable oils are blended from naphthenic and aromatic petroleum fractions, a typical complete specification for such an oil is given, together with details of test procedure for measuring gas absorption of oils under electrical stress. V. B.

2246. New tool for testing automobile waxes and polishes. J. D. Saunier and L. Kresser. *Soap, N.Y.*, July 1957, **37** (7), 73.—Radioactive tracers allow semi-quantitative comparison of initial thickness of wax films, determination of relative length of life or wear of films, and estimations of properties as well as of finish of wax films. G. A. C.

DERIVED CHEMICAL PRODUCTS

2247. History of petrochemistry. M. Moulin. *Bull. Ass. franç. Tech. Pétrole*, 1957, 291–316.—Capital investment (fr × 10^9) at end of 1955, and for 1956–58 inclusive, is as follows: U.K. 43·8, 44·5; Germany 30·8, 31·5; Italy 15·4, 28·4; Holland 3·2, 4·2; Belgium 4·2 (by end 1958); France 16·5, 45·5. French petroleum chemical industry is discussed (map) and product capacity tabulated for 1957 and 1960–61. It is considered that synthetic rubber and higher alcohols need development, aromatics supply appears assured. Polyethylene and poly*iso*propylene are largely interchangeable (comparative table of properties given), and choice will be price-governed. Chemistry and use of butadiene, *cyclo*pentadiene, and petroleum resins (polydienes) are reviewed. V. B.

2248. Detergents based on tall oil. W. B. Satkowski and W. B. Bennet. *Soap, N.Y.*, July 1957, **33** (7), 37.—Tall oil–ethylene oxide condensates give good detergency and low foam characteristics with low cost. The properties and uses of these non-ionic detergents are reviewed. D. K.

2249. Polymer non-ionic surfactants. W. L. Stanton. *Soap, N.Y.*, June 1957, **33** (6), 47.—The polymers produced by the addition of propylene and ethylene oxides to a suitable

nucleus, *e.g.* propylene glycol, produces a class of non-ionics having a controlled range of chemical structure and a wide range of properties. They are used commercially where their unique properties and combination of properties, such as low foam, excellent dispersive power, or flake form, can be utilized. D. K.

COAL, SHALE, AND PEAT

2250. Coal extraction. K. Kröger. *Erdöl u. Kohle*, 1956, **9**, 620–4.—Pt 3. Chemical and physical nature of the extracts; extraction and coking behaviour of the coals. Research is continued on the chem and physical nature of extracts from coal, using various org solvents, pyridine, phenanthrene, benzene, and ethylenediamine. Ultrafiltration and ultracentrifuging of the pyridine extracts and the electron microscope are used to determine particle size of the extract soln. Mol. wt. estimation of coal extracts—although many-sided and contradictory—confirms that both the true colloidally dissolved substances are present—with mol. wt. some 100 to >10,000—and the original fragments show a strong tendency to aggregation and polymerization. Micelles arise, with magnitudes of 0, 0·01, 0·1, and 1 μ favoured. The apparent mol. wt. and extract yield in pyridine extraction are given, also their dependence on preheating temp of the coals. An average mol. wt. of 657 was given for the coal material dissolved in phenanthrene. With carbonization degree and extraction temp—especially in the coal decomp temp range—the apparent mol. wt. decreases. However, the γ-fraction over the whole carbonization range has a fairly uniform mol. wt. of 400–500, whilst that of the β portion rises from 1300 to 4000. Pyridine extracts of coals <20% volatiles contain only small portions of colloidal aggregate, likewise the pressure extracts obtained at higher temp. Extract decomp with selective solvents, chromatographic separation of extract fractions, extraction, and coking behaviour are discussed. 34 refs. R. T.

2251. Partial air oxidation of Chattanooga Uraniferous black shale. C. R. Kinney and D. Schwartz. *Industr. Engng Chem.*, 1957, **49**, 1125–30.—The organic matter in Chattanooga black shale was investigated and found to have properties more related to a low-rank coal than an oil shale. Carbon and hydrogen contents were low and oxygen high, mainly due to groups of an alcoholic character. Partial air oxidn was found to destroy the alcoholic groups, and humic acids were formed. The acids were quinoid with attached carboxyl groups in structure, and contained a large amount of mineral matter. D. B. S.

2252. Petrographic and chemical investigations of Posidonian shales of Northwest Germany. (In German.) H. R. von Gaertner and H. Kroepelin. *Erdöl u. Kohle*, 1956, **9**, 588–92.—Pt 1. Petrography of the Posidonian shale. Tectonics and stratigraphy of the Jurassic sediments are described. The shales occur in a finest interstratification of calcareous deposits interspersed with quartz, and bituminous layers, essentially kaolinite and chlorite. A change from aerobic to anaerobic conditions, with regressions and transgressions in shallow marine waters, is indicated. The constant change between O_2-rich and O_2-free environmental conditions indicates that pT conditions favour petroleum-base bitumen formation, *i.e.* conditions are favourable for petroleum formation. Classification of org substances by (D.T.A.) differential thermoanalysis, which gives information on endothermic and exothermic reactions, is discussed. Numerous supporting curves are given with explanatory legends. R. T.

MISCELLANEOUS PRODUCTS

2253. Butadiene-2-methyl-5-vinyl pyridine rubbers for general purpose use. H. E. Railsback and C. C. Biard. *Industr. Engng Chem.*, 1957, **49**, 1043–50.—Elastomers of butadiene–vinylpyridine rubbers may be cured using a sulphur donor (4,4′-dithiodimorpholine) and a delayed action-type accelerator (*n*-oxydiethylene-2-benzothiazolesulphenamide) to give cpds that could be reinforced with carbon blacks and several pigments, and vulcanizates that have excellent modulus, hysteresis, and abrasion properties. D. B. S.

2254. Property changes of emulsion floor polishes. R. Rosenbaum, R. Bock, and R. E. Clark. *Soap, N.Y.*, Aug. 1957, **33** (8), 83.—Property changes imparted to industrial and household emulsion polishes by the addition of low mol. wt. emulsifiable polyethylene are studied. Tables show results. G. A. C.

2255. Waterless hand cleaners. W. J. Beach. *Soap, N.Y.*, June 1957, **33** (6), 43.—Waterless hand cleaners are considered from the following aspects: physical characteristics, testing and evaluation, physiological and safety factors, and specification buying. D. K.

CORROSION

2256. Survey reveals reformer corrosion data. E. B. Backensto. *Petrol. Refin.*, 1957, **36** (5), 201–4.—A survey of 31 companies, representing experience on all types of commercial cat reforming units and desulphurizers which use hydrogen, revealed that the most frequently encountered difficulties related to corrosion were excessive metal loss; heavy scaling of furnace tubes, exchangers, and/or transfer lines; plugging of cat beds and fouling of heater and exchanger tubes. The most widely used methods to combat and/or control corrosion are proper alloying, generally with 18–8 chromium–nickel stainless steel at high temp; feedstock desulphurization; hydrogen sulphide removal in recycle gas; and aluminizing. J. R. T.

2257. Approaching problems of cooling water corrosion. M. C. Forbes. *Petrol. Refin.*, 1957, **36** (4), 164.—This article presents a brief derivation of an equation for the average penetration rate of an iron surface in contact with cooling water. From the application of this generalized equation the author concludes that the 2 major factors that must be considered in cooling water corrosion inhibition are the effect of the conductivity of the cooling water and the effect of the inhibitor on the cathodic and anodic areas of the corroding material. Changes in oxygen content of the water or changes in pH appear to have less effect than has been usually thought unless these variables are changed sufficiently to alter the basic nature of the corrosion reaction. J. R. T.

2258. Low pH *v.* high pH in crude oil units. J. A. Biehl and E. A. Schnake. *Petrol. Refin.*, 1957, **36** (5), 199–200.—This is a report of studies of operation and corrosion of a crude oil unit at high and low pH control of overhead receiver waters. The studies resulted in the reduction of the pH of receiver waters to an average 4·3, with inhibitor injection varying from 10 to 15 p.p.m. Subsequent corrosion data indicated excellent protection of the equipment. The most widely used method of corrosion control was to maintain the pH of receiver waters at levels of 7·0, or higher, by injection of

ammonia. It was found, however, that this had adverse effects on subsequent refinery processes and often resulted in more severe corrosion of such processing equipment.
J. R. T.

2259. Modern ground bed design saves money. J. E. Searcy, Jr. *Pipe Line Ind.*, 1957, **6** (3), 24–7.—A time-saving chart and a monograph are presented to assist the engineer in new ground bed design or revision of old ones. R. T.

2260. Properly placed anodes protect station piping. R. G. Ransom. *Pipe Line Ind.*, 1957, **6** (3), 20–3.—Early cathodic protection systems at Tennessee Gas Transmission Co's compressor stations used large conc impressed current ground beds on the edges of station yards. These beds provided current to cross-country transmission lines and most of the lines within the plant. As the stations grew and protection was no longer furnished for piping inside the plant, distributed anodes were installed to improve protection. Procedure is illustrated and discussed. R. T.

2261. What makes a good pipeline coating? W. F. Fair, Jr. *Pipe Line Ind.*, 1957, **6** (3), 28–32.—Existing spec are based chiefly on observed val for materials which have given years of satisfactory service under various kinds of application conditions and underground corrosion environment. Lab spec tests presented, and field experience, ensure required batch and shipment reproducibility and availability of standard material. R. T.

2262. Lets look at electrical grounds. W. H. Stewart. *Pipe Line Ind.*, 1957, **6** (3), 37–8.—Copper-ground plates or rods placed near steep pipe or other buried equipment create a potent cell which causes rapid pitting of the steel. The question of grounds is discussed. Steps are listed for correct grounding of a vessel handling crude and petroleum products. R. T.

2263. Keep tab on corrosion control programme. O. W. Everett. *Pipe Line Ind.*, 1957, **6** (3), 33–6.—Proper planning ahead of construction will eliminate many problems. Areas to be avoided are listed. For an operating line a set of records as presented will indicate performance and the economics of protection. R. T.

2264. Taking the mystery out of rectifiers. W. Johnson. *Pipe Line Ind.*, 1957, **6** (3), 39–44.—Use of rectifiers for cathodic protection of pipelines is discussed critically. A wiring scheme and wave form sketches are given for pipeline rectifiers. Operating principles, rating factors, and construction features to be followed are given. R. T.

2265. Moisture and vapour transmission in asphalt pipe enamels. L. F. Bramble. *Pipe Line News*, 1957, **29** (7), 50–4.—Asphalt pipe enamels are impervious to moisture even during the transition period through which all asphalts pass. Cases of coating failure may be traced either to improper mixing or application, or to breaks in the applied coat.
D. B. S.

2266. The importance of primers in pipe enamel application. L. F. Bramble. *Pipe Line News*, 1957, **29** (6), 49–50.—A good primer must form a strong, stable, permanent bond between the enamel and the surface by reducing interfacial tensions. Secondly, it must have good tensile strength and adhesion to resist stresses greater than the cohesive strength of the pipeline enamel. Finally, it must be completely compatible chemically with the enamel and must not be affected during the enamel application. Other requirements are discussed and methods of achieving them, and in particular the interfacial requirements, described. D. B. S.

2267. How to stop corrosion under insulation. H. M. Wilten. *Petrol. Refin.*, 1957, **36** (4), 192.—The corrosion of steel under insulation is primarily caused by oxygen and moisture. This paper outlines an insulation specification for pipelines and equipment of 36 inches and less in dia. The suggested practice, which covers methods of application for insulation in the temp range atmospheric to 250° F, is grouped under 3 main headings, namely, preparation of surfaces, material, and application. The author lists 8 corrosion problems from actual experience and outlines the method of solution of these.
J. R. T.

2268. Phenol corrosion of lead. (In German.) H. Walther. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (12), 451–2.—Phenol corrosion results in lead sheaths of cables whose wrapping is impregnated with coal tar products. The corrosion—in the form of severe pitting and intercrystalline attack—gives as products lead carbonates and basic carbonates. No relation appears between phenol concn and corrosion intensity. Factors increasing the lead attack in presence of coal tar impregnating media are presence of moisture in the textile bandages, microbiological destruction of textile fibres and org acid formation, immediate contact of the textile fibres with the metallic lead, environmental conditions which make difficult washing out or vaporizing of acids formed. R. T.

ENGINES AND AUTOMOTIVE EQUIPMENT

2269. Free piston engines for the oil industry. A. F. Gillingham. *Petrol. Times*, 30.8.57, **61** (1567), 763.—Potential applications in the petroleum and petroleum chemical field are outlined, including use in tankers. Diagrams illustrate 7 typical applications, including pumping stations, drilling rigs, and generating sets. G. A. C.

2270. Supercharging old engines really pays. C. S. Kenworthy. *Oil Gas J.*, 5.8.57, **55** (31), 77.—Vertical and horizontal gas engines supercharged give excellent performance, with lower operating costs, lower investment for added h.p., and larger loads may be handled without creating unsatisfactory heating conditions. G. A. C.

MISCELLANEOUS

2271. Expansion in the world oil industry in 1956. C. G. Watts and F. Powell. *Inst. Petrol. Rev.*, Aug. 1957, **11** (128), 201.—Trends in the progress made by the petroleum industry are reviewed for the preceding year. Pt 1 deals with free world demand, and its pattern, bunkers, quality, refineries, production, and exploration. Pt 2 concerns oil movements, European supplies and impact of Suez Canal closure, tankers and freight rates, export prices, and future expansion.
G. A. C.

2272. Patents in the petroleum industry. J. T. Tyson. *J. Inst. Petrol.*, 1957, **43** (402), 167–80.—After a brief discussion of the development of the patent system, the author describes the procedure for obtaining a patent for an invention in various countries. The role of the patent system in the encouragement of research and development and in the provision of technical information is stressed. Finally, the practice of patent licensing is described and discussed. 5 pages of discussion. C. B.

2273. Symposium on staff training: Recognition of the need for training. T. L. Stephens. *J. Inst. Petrol.*, 1957, **43** (401), 131–7.—The author defines the need for training, and explains that although the requirements of individuals will vary according to previous education, training schemes should be integrated throughout the organization. The functions of the training officer are described after a discussion of training needs at different levels and of different types of people. C. B.

2274. Oil taxation. Canadian v. American. A. G. Burton. *Oil Gas J.*, 19.8.57, **55** (39), 164.—A critical appraisal is given in Pt 1 of this article, with advantages and disadvantages for each side in Canadian operations. G. A. C.

2275. Rate of return calculations as a measure of investment opportunities. J. W. Glanville. *J. Petrol. Tech.*, 1957, **9** (6), 12–15.—An investment evaluation must be based on an accurate forecast of the economic life of the project. Distribution of overheads is difficult, and care must be taken to note money already committed. The effect of income on other existing or potential operations must be included, as well as taxation. Projects have different lives, investments, profits, and risks; some may be very attractive, others the reverse; selection is then easy. Many will be in the range marginal to good, requiring careful study. Pay-out time (time for earnings to repay original investment) affords a coarse basis for assessment, but does not give a measure of the project's ultimate earnings. The profit to investment ratio may be helpful if note is taken of the time factor. Discounted values help in this connexion, but there are difficulties in choosing discount rates. The interest rate of return (discounted cash flow method) is another approach. It involves finding the interest rate that discounts future earnings of a project down to a value equal to the project cost. This approach has virtues, and examples of its use are given. The cash-flow rate of return is only slightly affected by long deferred earnings, but these may be of importance to a company remaining in business. G. D. H.

2276. Research leads to more sales. Anon. *Oil Forum*, 1957, **11**, 53.—The val of research to the petroleum industry is discussed, with particular reference to the expanding work of Leonard Refineries Inc., Alma, Michigan. R. T.

2277. The rise of a hot waste gas plume. C. H. Bosanquet. *J. Inst. Fuel*, 1957, **30** (197), 322.—An equation is developed for finding the track of hot gases rising from a chimney at any wind velocity. The height to which the waste gas rises depends on its heat content and its exit momentum. Tables are given for calculating the combined effect. It is also shown that if the temp gradient is less than adiabatic the smoke will settle at a definite height. Discussion of this paper appears on p. 333 of this journal. D. K.

2278. Do profits keep pace with octanes? S. W. Curry. *Oil Gas J.*, 5.8.57, **55** (31), 68.—During the next few years it is anticipated that gasoline quality will advance steadily at the rate of 1–2 research numbers per year, and to meet this demand the producer will have to make new plans or revise his processing. Either way is costly, but it is calculated that a net advantage of 91 c/brl for the 100 octane product should result. G. A. C.

2279. Technical use of tall oil. (In German.) *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (12), 458–62.—A comprehensive review including items of interest to the petroleum industry. R. T.

2280. Fluid catalyst design data. Pt I. How solid catalysts behave. F. A. Zenz. *Petrol. Refin.*, 1957, **36** (4), 173.—The first of a series of articles which is to cover the principal aspects of fluidization and orient this unit operation with the general subject of fluid–solid behaviour in better understood and related fields. This article explains and discusses the 5 commonly encountered angular properties of granular materials, namely, angle of internal friction, angle of repose, angle of wall friction, angle of rupture, and angle of slide. 5 methods for experimental determination of the angle of internal friction are given. J. R. T.

2281. Chemical cost and profitability estimation—1956. J. B. Weaver. *Industr. Engng Chem.*, 1957, **49**, 936–46.—This annual review includes sections on costs of investment, equipment, manufacture, and finished product; estimated chemical product and petroleum refining data; estimating techniques; profitability; capital budgeting; inflation and cost indexes; research evaluation; and engineering economy and operation research.

The published material is discussed, and a very comprehensive bibliography and subject index included. D. B. S.

2282. The explosion in M.V. *Atlantic Duchess*. Anon. *Petrol. Times*, 30.8.57, **61** (1567), 752.—The sequence is given of the events leading to the explosion and fire on 2 Feb. 1951 at Swansea, with judgment by Mr Justice Pearson on the subsequent action, findings being in favour of the defendants, the British Petroleum Co. Ltd. G. A. C.

2283. Soviet petroleum industry's tasks for 1956–60—directives of the 20th Congress of C.P.S.U. R. Piatkowicz. *Nafta (Krakow)*, 1956, **12**, 238–42.—During the last 5 years petroleum production rose by 87%, and for the next 5 years it is anticipated that it will rise a further 91%. In 1956 it is expected to reach 135 million tons, whilst proved reserves of petroleum will rise by 65–70% and gas by 80–90%. Since the end of the war new deposits have been discovered in the Ural–Volga region which supplies Siberia and the Far East. New pipelines are envisaged for Tuymazi–Omsk (second), Omsk–Irkutsk, Ufa–Omsk (second), Novosibirsk–Irkutsk, etc. Production of transportable rigs is going to increase. Drilling costs will be lowered by 35–40%. Productive drilling must rise by 85% and exploratory drilling by 95%. Secondary production is to go up by 82%. It is observed that costs of production in certain regions, in particular W. Ukraine, are more than double that for the whole of the U.S.S.R. In all regions productivity will be increased. *Ca* 40% of the gas produced, together with crude, is now burned, whilst there is a shortage of C black. New refineries of 45 million tons total throughput and 25 million tons cracking capacity are planned. Increased production of chemical intermediates and solvents is imperative. By building large dia pipelines, pumping throughput is to be increased sixfold to 83,000 million tons/km. M. S.

2284. Petroleum industry's tasks—7th general meeting of P.Z.P.R. Z. Zborowski. *Nafta (Krakow)*, 1956, **12**, 233–8.—A review of the last 6-year plan showed that over the period 1,110,000 tons of crude were produced, *i.e.* 69·8% of the figure aimed at (1,590,000 tons). Gas produced reached 1842 million cu. m. (aim, 2088). In 1955 the crude produced was 180,000 tons and consumption reached 1,680,000 tons. Refinery capacity was nearly 4 times as large as supply of domestic crude. 6-year drilling results were 303,000 m productive and 359 m exploratory drilling, the total being *ca* 60% of planned figures. On the other hand, the petroleum equipment factory has become the mainstay of progress. For the future, 5-year plan envisages 180,000 m drilling in the Carpathians, 91,000 m in the foothills, and 214,000 m in the lowlands, in an opposite pattern to the one which characterized the previous 6 years and was proved wrong. The aim of this drilling will be to discover new deposits in the lowlands, and several types of seismic apparatus will be used. No forecast is made of how much domestic crude is expected in

the next 5 years, but secondary production will be most important. Refining capacity in 1956 should reach 1,000,000 tons. By 1960 consumption will reach 3 million tons. M. S.

2285. Research Council of Alberta Report for 1956. Anon. *Nature, Lond.*, 1957, **180**, 176.—Among the work connected with petroleum is a geological survey of large areas in the N. and W. Pyrolysis of *n*-butane to yield unsaturates has been studied, together with adsorption techniques suitable for separating hydrocarbons.

The V, Ni, and porphyrin content of crude oil is being studied, and the characterization of S cpds in oil-sands oil is under way. H. C. E.

2286. Great Britain grapples with a fuel shortage. C. A. Neal. *Oil Forum*, 1957, **11**, 56–8.—The adverse effects of interruption of oil flow from the Middle East on European economics are discussed. Decline of coal production leaves a margin in Great Britain to be filled by *ca* 25 million tons of oil. Nuclear energy may be available by 1965 equiv to 13 million tons of coal. Even with this achievement, the gap between Britain's demand for energy and available fuel supplies will still be *ca* 57–63 million tons. Effects of fuel shortage and financial cost are discussed. The U.K. has a small indigenous fuel production, *ca* 1343 b.d. from 7 small fields. Search continues offshore. Present refining capacity of 631,850 b.d. will be increased by planned addition of 319,500 b.d., to be on stream within 2 years, bringing the total to 951,350 b.d., the largest in Europe. R. T.

2287. French oil industry equipment in relation to the homeland and the Sahara. P. Lauras and G. Henry. *Bull. Ass. franç. Tech. Pétrole*, July 1957, 317–34.—The first well was drilled in France at Gaujacq in 1890, and up to 1936, 150 wells aggregating 30,000 m had been drilled using old percussion rigs. Deep rotary drilling started at Pic-Saint-Loup in 1938. In 1939 gas was found at Saint-Marcet. Work continued during the war under difficulties. In 1945, 12 rotary rigs were available and 22,000 m were drilled. The first French tricone bits, tool-joints, and drill-collars were made in 1941; in 1948 a well at Bastennes reached 4190 m, a European record; nearly 200,000 m were drilled in 1950. In 1953 S.M.F. produced tricone jet bits, while in 1956, 6000 pairs of tool-joints were exported. Drill-collars, originally produced at the rate of 3 per month, were expected to be 70 per month in mid-1957. 8500 tricone bits were made in 1956. Various items were manufactured under licence, including Failing rigs. Equipment for cementing, for the treatment of mud, and for controlling production has been made.

In 1938 French refineries could handle 8,000,000 tonnes of oil p.a.; the figure was 31,000,000 tonnes in 1956, having been 1,500,000 tonnes at the end of the war. Special steels and techniques have been developed, and now refinery construction calls for little if any imports. A 2,000,000-tonnes p.a. refinery needs *ca* 30,000 tonnes of ordinary steel, 400 tonnes of special steels, and 300 tonnes of non-ferrous metals.

Refinery storage capacity now approaches 6,000,000 m³, while depots for distribution total 2,800,000 m³. 5600 road tankers and 11,500 tank wagons are now available. There are 90 tankers, and port facilities at Le Havre will be able to handle tankers up to 100,000 tonnes. There are 250 special tank wagons for butane and propane.

Considerable amounts of refinery and transportation equipment have been exported.

Saharan operations will involve pipelines to the coast, and ultimately 10,000,000 tonnes of oil p.a. are expected to be transported. Developments at Hassi Messaoud, Edjélé, and Tiguentourine are expected to call for 300 wells. G. D. H.

2288. Foreign review. Anon. *Nafta* (*Krakow*), 1956, **12**, 256–9.—Review includes details of the pipeline from Stavropol to Moscow, which will be 1300 km long, 700 mm dia, and will take gas from a depth of 750–850 m over 65 rivers and many other obstacles to Moscow, and the localities near which it will pass. It is hoped to complete it in 1957, when it will carry *ca* 1 million cu. m/day. All along its length telephone and radio communications will be maintained. Low S and high paraffinic content account for the popularity of Rumanian crude abroad. 16 new oilfields have recently been discovered in Chinese provinces of Kwansu, Shentsi, and Inner Mongolia. M. S.

BOOK REVIEWS

Chemical Engineering Kinetics. J. M. Smith. New York: McGraw-Hill Book Co. Inc., 1956. Pp. 402 + ix. 60*s*.

"During recent years the science of chemical kinetics has advanced rapidly. The absolute rate theory has stimulated theoretical progress, and new experimental techniques have improved rate data. Catalysis is better understood than heretofore, and progress has been significant in interpreting processes where chemical reactions are accompanied by physical transfer operations. Taken together, these advances make it possible to present sound design methods for several types of reaction equipment and thus bring reactor design closer to the stage of development achieved in the unit operations. This book has as its objective the presentation of these design procedures and their application to practical problems."

The above quotation from Professor J. M. Smith's preface to his text-book on chemical engineering kinetics summarizes the author's objectives. For some time students and lecturers have realized the great need of a satisfactory text dealing with the application of chemical kinetics to reactor design. In part the subject had been dealt with in Pt II of Hougen and Watson's classic "Chemical Process Principles," but a further treatment, including many more practical applications and tutorial problems was required. In particular, students studying for external examinations without the guidance of a lecturer and graduate chemical engineers wishing to maintain an up-to-date knowledge on design principles will find Professor Smith's book of the greatest value.

A brief introductory chapter is followed by review chapters on thermodynamics and kinetics and an introduction to reactor design. Chapters 5, 6, and 7 deal respectively with homogenous batch reactors, homogenous flow reactors, and semi-batch reactors. Chapter 8 deals with the theory and classification of catalytic reactions, and Chapter 9 with the kinetics of solid catalytic reactions. Chapter 10 deals with heat and mass transfer in reactors, including both fixed and fluid beds, and Chapter 11 extends the study to the design of gas–solid catalytic reactors.

There are two appendixes which extend the theoretical treatment; Appendix A, which deals with the application of the absolute rate theory, and Appendix B, which deals with radial heat transfer studies in packed-bed reactors.

A large number of worked out examples are included in the book, and a number of unsolved problems given at the end of each chapter. The examples have been carefully chosen to illustrate a particular principle, and where they have been taken from actual industrial practice have been simplified to avoid the necessity of too many reference tables and data. In this sense the book is very complete,

and many practising chemical engineers will find it most stimulating and interesting reading as well as having important practical applications. For those who wish to refer to the extensive literature on the subject, references are given in the body of the text to the most important papers. The book is well indexed and produced, and is highly recommended to students, teachers, and practising chemical engineers alike. F. M.

The Chemistry of Petrochemicals. M. J. Astle. New York: Reinhold Publishing Corpn; London: Chapman and Hall, 1956. Pp. v + 287. 52*s*.

Those who have been waiting for a really comprehensive work on the modern petroleum chemical industry will be disappointed. The pace of development of the industry is such that few engaged in it will have the opportunity of undertaking this task. Judging by his book, Professor Astle finds it difficult to digest the mass of data available, not knowing which is real and which hidden by the skilled chemist drafting an article or patent specification which claims the maximum with a minimum of disclosure.

The book, having been published in the U.S.A., largely overlooks the very real contributions made in Europe. In the chapter on acetylene, several of the newer European developments are left out, and while the non-commercial Schoch process developed in the U.S.A. is given four paragraphs, the large-scale Hüls arc process is not even mentioned. On p. 131 the statement that "Hypersorption seems to be somewhat more economical and is being used in the newer plants" (for acetylene separation), appears to be widely off the mark. Again looking at p. 133, the author should be told that acetone was made commercially for a long time from carbide acetylene.

The chapter on the preparation of olefins would be greatly improved through inclusion of descriptions of the widely used processes for steam cracking of gaseous and liquid feedstocks. Provision of simplified flowsheets in all sections would add considerably to an understanding of the text.

The book contains a more than fair share of misprints and errors. "Marlex" is called "Mylar" (p. 103), Professor Ziegler's name is consistently mis-spelt, and other errors include "Aerosorb" (p. 154) and "Caterole" (p. 157).

In discussing *iso*propanol manufacture by sulphation, the author's yield figures on propylene and acid would appear to be rather low. Although direct hydration of propylene is referred to on p. 17, no mention is made of the commercial plant which has been operating in the U.K. for the past five years.

Judging by his references, and indeed the text, the author has been an assiduous reader of the patent literature. Unfortunately, he has failed to add his grain of salt, with the result that the newcomer would fail to distinguish a commercially practical from a laboratory reaction. It is doubtful, for example, if the commercial production of butadiene from ethylene by dimerization to butylene, and its subsequent dehydrogenation, has ever been seriously considered. In the same field, no mention is made of the well-known Houdry, Shell, and Dow dehydrogenation catalysts.

The arrangement of the subject matter leaves much to be desired, and there is considerable repetition, *vide* p. 160, where successive paragraphs repeat in almost identical words that about 1 lb of aluminium chloride is required for every 75–100 lb of ethylbenzene produced.

The author and his publishers rightly considered that there was a requirement for a book on petroleum chemicals. Possibly a greatly revised and improved second edition will meet this demand. H. W. S.

Gas Chromatography. A. I. M. Keulemans. Ed. C. G. Verver. New York, Reinhold Publishing Corp; London, Chapman and Hall, 1957. Pp. xix + 217.

The ever-increasing use of petroleum as a raw material for the manufacture of special products by synthesis has resulted in a growing demand for methods of analysis capable of revealing the composition of such complex material in more detail. This demand is by no means absent when normal petroleum products have to meet the exacting needs of modern machinery and equipment. An analytical tool showing great promise in this connexion is the comparatively young technique of gas chromatography, which has developed at such a phenomenal rate over the last few years. The author is to be congratulated on producing at such an early stage a manual which summarizes admirably the practice and theory of the many and diverse problems to which gas chromatography has already been applied.

Judged by the wide and varied response to the Gas Chromatography Symposium sponsored by the IP Hydrocarbon Research Group in May–June 1956, this publication will be welcomed not only by the petroleum technologist but also by workers in many other allied fields. The text begins with a proposed definition of chromatography in general and a classification of its sub-divisions, and continues with adequate descriptions of analytical applications and apparatus. The roles of supports, mobile and stationary phases as they affect separation are dealt with from a theoretical standpoint and, in an appendix, the designs of katharometers described.

Bibliography references are given in each chapter, with an author index, but no general subject index. The latter would appear to be an unfortunate omission. H. C. R.

Pilot Plants, Models, and Scale-up Methods in Chemical Engineering. R. E. Johnstone and M. W. Thring. New York, London, Toronto: McGraw-Hill Book Co., 1957. Pp. xi + 307. 71*s*. 6*d*.

The title of this book conveys a fair impression of its scope. In their treatment, the authors ably fulfil a very definite need. The book is also to be commended in that the scientific objective of engineering research and development is so clearly presented. The preliminary chapters, in particular, will greatly assist the fundamental scientist as he starts to apply his training to the complexities of engineering problems.

The treatment develops from the principle of similarity and the powerful method of dimensional analysis. The engineering starting point is often a differential equation too complex for mathematical integration which, however, may be usefully resolved into the three constituent factors: a driving force or potential difference; a resistance factor or its reciprocal, a conductance; a resultant. From these considerations the applicable dimensionless groups are extracted, such as the Reynolds group, which is the ratio of inertial to viscous forces in the flow of fluids, and the Weber group, which is the ratio of inertial to surface tension forces.

The fact that dimensionless similarity criteria are ratios of physical quantities which are functions of the given problem means that there may well be several mutually incompatible dimensionless criteria as the scale of the problem is widely changed. Thus it may readily be possible to satisfy two criteria within limits, but it will seldom be possible to satisfy three even by model distortion. If possible, it is advantageous to choose conditions such that the rate of the process, say, is predominantly a function of one dimensionless criterion. From the first hundred pages it is readily appreciated that the requirements of a pilot

plant which must yield a given product may preclude the use of strict similarity with the full-scale production plant, and the problem of extrapolation to larger scale equipment is discussed.

At each stage in the development of the subject the principles involved are illustrated by numerous examples. The implications are then considered in more detail in separate chapters dealing with: ducts and flow passages; filters; heat transfer equipment; packed towers; mixing equipment; chemical reactors; furnaces and kilns; miscellaneous equipment; corrosion. A pertinent chapter reviews the general theory and application of analogue models.

In criticism, the authors have found the need to develop new shades of meaning for familiar terms. It is a little disconcerting to be faced with Appendix I, Terminology, but the general reader should experience little confusion, and care is taken to explain modified usage when introduced within the text. The use of bold-faced type to denote ratios of corresponding quantities neatens presentation but goes against a valuable convention; the casual reader will be misled into thinking that extensive use is made of vector methods. However, the book should interest any but the most casual, and this should be its own safeguard against misinterpretation. J. S. M. B.

British Diesel Engine Catalogue. Edited by D. S. D. Williams. 4th Edn. London: Temple Press for BICEMA, 1957. Pp. 317 + xlviii. 52*s*. 6*d*.

Descriptions and tabulated information concerning 2893 engines of 43 makes are included in this new edition of the catalogue of British diesel engines prepared and published for the British Internal Combustion Engine Manufacturers' Association. All types of industrial, railway traction, and marine models are covered, including free-piston, dual-fuel, convertible, and gas engines and the horse-power ranges from 1·5 to 15,600.

The introductory matter incorporates data regarding oil engine working principles, definitions of terms, power requirements, etc. A unique "lightning index" is provided from which can be easily traced references to engines by the purpose for which they are to be used and the b.h.p. required. Where necessary, translations in French, Spanish, Portuguese, and German are provided.

In the section on descriptive matter (317 pp.) much data and information likely to be of value to the power engineer are provided by the members of the Association.

The volume is to be recommended.

Fundamentals of Combustion of Gaseous Fuels. A Critical Literature Review. S. A. Weil, R. T. Ellington, E. F. Searight, and S. Hu. Institute of Gas Technology Research Bulletin 15. Chicago, Ill.; The Institute 1957. Pp. 64. $5.00.

The use of gas as a source of energy is linked with the combustion process, and the object of the study reported in this bulletin was an extensive search of literature on various aspects of combustion. For this survey over a thousand references published before the autumn of 1955 were consulted, and of these some 200 have been critically reviewed. The more significant findings and opinions are summarized, and the limitations of the present understanding of certain phases of the combustion process pertinent to the gas industry are discussed.

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